Plastic and Reconstructive Surgery

A MANUAL OF MANAGEMENT

By

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TO

ALIDA DELAN

My Mother

AND

FLORENCE

My Wife

Whose inspiration unfailing cooperation, understanding and sound judgment have determined whatever we may have accomplished

Preface

The purpose of this manual is directive It is not to teach the beginner in this special field except through a preceptor who has basic training, experience and competent judgment

Rather it is the author s purpose to point out and emphasize that the teaching and trend of plastic surgery since World War I have been so influenced by the description and popularization of the tubed pedicle and its conveyed flaps by the use of Indian forehead flaps in facial repair by the popularization of the skin grafts of Thiersch Reverdin and Wolfe, together with excellent mechanical methods of obtaining these that many of the previous procedures of choice have been forgotten or ignored

Further it is the author s belief that contemporary new technical procedures have not received the attention they deserve in permitting the discharge of the surgeon s full responsibility Procedures popularized and largely followed during these years have been those of necessity where "no choice of procedure" is possible They rarely if ever, permit correction of the cosmetic disability which in the majority of cases is half if not all of the surgeon s responsibility Today, it is only occasionally that he does not have a choice of procedure Haste in reconstructive surgery is made slowly Time is the friend of both the surgeon and the patient Judgment in planning and procedure derive not only from knowledge of sound basic principles but also from experience

The author does not assume a complete knowledge of all related literature and methods. His only endeavor is the presentation of basic principles which are correct and a method or methods of application which consistently discharge the surgeon s obligation and produce mutually satisfactory results.

The accomplishment of such results depends upon the intelligent cooperation—teamwork—of all practitioners concerned from the time of the initial visit until the patient is discharged There are many borderline cases occurring in general genito-urinary and orthopedic surgery, dermatology and so on It is the author s belief that such conditions as hypospadias, epispadias and the like should be corrected by the urological surgeon, absence of the vaginal tract by the gynecologist many of the lesions of the tendons, nerves and bones of the hands and feet by the orthopedist There are however several congenital conditions of the hands and feet as well as traumatic losses and disabilities whose successful reconstruction depends upon the skillful appraisal planning and management of a surgeon experienced in the design of flaps and grafts and scar contraction In many of these situations collaboration produces the desirable result Such accomplishment must result from avoidance of many

Chapter I

GENERAL CONSIDERATIONS

The object of all real surgery is the restoration of a part to normal or as near to normal as possible The "normal" includes not only *function* but also *cosmetic* condition The very nature of most surgery requires maximal attention to the former and little if any, concern about the latter It is true however that surgeons dealing with exposed parts particularly the head neck and hands, have striven for centuries to give that concern to cosmetic condition which it deserves

The plastic surgeon must constantly evaluate this dual responsibility sometimes yielding something of the possible functional efficiency to desirable cosmetic results and vice versa. At other times the question of function is not involved at all—the surgeon must undertake alteration of appearance for reasons equally important

The patient has a right to expect and demand the optimal result which can accrue from a highly cooperative professional service and a skill which results from the utilization of all that is best in the general and special experience related to his particular problem His future mental comfort and success in the competition of living will be *materially* influenced by his function and appearance The desired results may be accomplished only by the understanding and cooperative effort of the entire professional personnel concerned from the moment of his arrival until he is discharged from management

This text is concerned with fundamentals—essentials to successful outcome—and with operative procedures which embrace the best of

present knowledge and experience These are not the only methods of accomplishing acceptable results They are directive They are presented with the assumption that the surgeon will not deviate widely from the principles involved unless his end result fully justifies such departure

The don't s throughout the text are as essential as the things to be done If shift from the indicative to the imperative mood will aid toward brevity or desired emphasis the shift is made

A thousand mile journey begins with the first step " Not only does the surgical care of the patient begin at the moment he appears but also the *plan* of that care must begin to take form with his first aid. Each successive service rendered must contribute to and in no wise subtract from, the end result.

SIMPLE ESSENTIALS

Transportation, Industrial and Domestic Accidents

The increasing number of such accidents and the frequency of mistakes in the immediate management of the patient are the occasion for this discussion

Correlation and continuity of effort begin at the time of the initial visit and follow through until the patient s release from management He should not be moved until examined by a competent surgeon or an experienced ambulance attendant. The following must be determined and managed —

1 Hemostasis
2 Drugs as indicated
3 Support of tongue (mandible loss)
4 Clear airway (rubber airway)
5 Removal of tooth fragments *free* bone (no attachment) and debris
6 Splinting of broken bone fragments
7 Fracture of mandible thoracic cage pulmonary hemorrhage

At Hospital. The surgical team, as such, has its first contact with the casualty at this point. Cooperation and consultation of the reconstructive surgeon and the related specialists begin here and continue until the patient is discharged.

1 Manage shock (p 153)
2 Anesthesia (p 203)
   (*a*) Local anesthesia is desirable and adequate in most instances The drugs used are pentobarbital sodium (0 1 to 0.2 gm or 1¼ to 3 grains) and procaine (0.5 per cent) containing 15 minims of epinephrine to the ounce (30 cc), this quantity is not to be exceeded whether used for block or infiltration The latter controls capillary bleeding and surface oozing to a large degree
   (*b*) General anesthesia inhalation intratracheal intravenous or rectal as desired.

3 Hemostasis
(*a*) The tissues should be carefully handled with sharp hooks and sponged gently Use a suction pipet if one is available
(*b*) Use small hemostats and fine ligatures Include minimal amounts of tissue in the ligatures Employ high frequency coagulation for small vessels and weeping surfaces if this equipment is available All this minimizes shock and promotes rapid healing
(*c*) Ligate locally and not in the course of the vessel if possible Maximal blood supply is needed in the repair of the area
4 Transfusion as indicated (p 153)
5 Cleanse the area thoroughly with soap water, gauze or an accepted detergent Investigate all tracts Flush with saline solution Use débridement judiciously but thoroughly conserving all essential structures Soak with 1.5 per cent iodine or merthiolate (acetone solution)
6 Reduce any fracture and use immobilization (see Maxillary Wiring p 67) *Conserve all bone* and fix it in place
(*a*) Support the tongue and other structures in fractures and loss in the mandible (Fig. 69, p 94)
(*b*) Extra-oral traction appliance to support collapsed tissues Tracheotomy as required

Approximate carefully the lining to the skin with fine sutures properly tied Immediate closure reduces the probability of infection and results in less scar and distortion and consequently, easier and better reconstruction This statement applies to patients receiving care within six hours after injury

7 Place a small Penrose drain
8 Give perfringens antitoxin or tetanus antitoxin if the patient has not been immunized with tetanus toxoid
9 Alcohol dressing (70 per cent)
10 Indicated splinting and bandaging for comfortable transportation
11 Transfusion as indicated (p 153)

Period of Incubation of Infection (Five to Ten Days)

1 Appropriate supportive treatment whole blood blood plasma glucose saline solution ferrous sulfate liver vitamins
2 At first evidence of local inflammation
(*a*) Immobilization of soft parts and bone (splinting and proper bandaging) physiologic rest refrigeration
(*b*) Moist heat saline or magnesium sulfate solution with sodium chloride A "pinch of sodium chloride added to the magnesium sulfate solution serves as a catalyzer to improve materially its action
(*c*) Chemotherapy Give sulfonamide drugs and/or penicillin empirically until a culture establishes the type of infection

Skin Covering: *French or Sliding Flap* (Fig. 1) This method has a limited use when employed alone This flap is "slid" or advanced from its original bed with little twisting or torsion of its pedicle It is widely used alone for the repair of small defects and combined with other

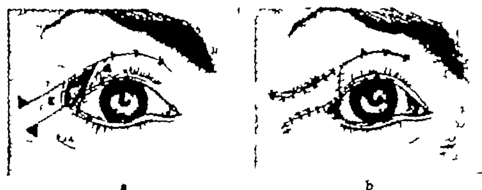


Fig. 1 French or ("sliding") flap *a*, in process *b* complete. The significance of the letters on the face of the illustration is evident in Figure 274 with part of which Figure 1 is identical.

types is essential to the repair of defects in all parts of the body It is the basis of the author's conception and management of the replacement of large surface disabilities by multiple excision This may em

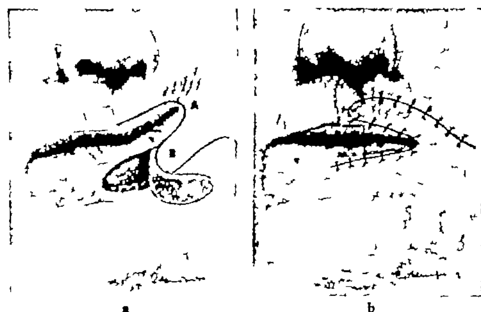


Fig. 2. Interpolated (rotated) flap *a*, in process *b* complete. The significance of the letters on the face of the illustration is evident in Figure 381 with part of which Figure 2 is identical.

brace the shifting or "sliding" of the skin of half or more of the cheek and neck in an initial procedure (see p 345) It is useful in masking a loss of surface tissue but should never be used alone in repair of other large partial or total losses (muscle supporting tissue lining) because

rapid scar contraction and deformity result Its successful use in the repair of a cavity always demands a *lining* of mucous membrane or skin

Interpolated Flap This is a desirable method for repair of many major lesions These flaps have almost become a lost art since the



Fig. 3



Fig. 4

Fig. 3 Outline of rectangular flap preparatory to tubing and folding.
Fig. 4 Tubed pedicle and flap.

popularization of tubed pedicles and skin grafts Imrie used them excellently during and since World War I Several methods of obtaining tissue for interpolation may be defined

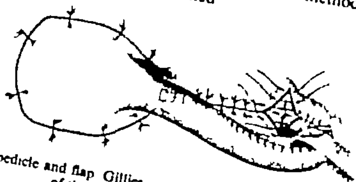


Fig. 5 Tubed pedicle and flap Gillies method. Mattress suture to close the apices of the two areas in the tube and bed.

FLAPS FROM IMMEDIATE NEIGHBORHOOD Such flaps are single or double with a pedicle which is rotated twisted bridged or tunneled (Fig. 2 see also Figs 366 370 372 425 427 435) This is the *Indian* mutilation type of flap The pure Indian type of flap was raised from the forehead rotated on a pedicle and used without lining for nasal repair This flap is a method for large partial or total nasal covering and *rarely a method of necessity in covering* large losses of the cheeks

and lips. An excellent modification of this flap for nasal covering is New's "sickle flap" from the hair-bearing scalp



Fig. 6

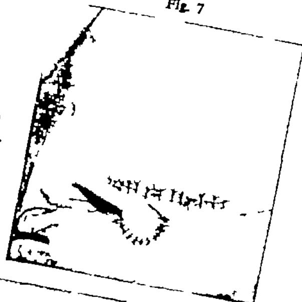


Fig. 7



Fig. 8

Fig. 6. Modification of Italian method. Tubed arm pedicle to the nose. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Fig. 7 Modification of Italian method. Tubed pedicle flap from abdomen to wrist. The arm is to serve as a carrier

Fig. 8 Modification of Italian method. Tubed arm pedicle to the face (Smith method of fixation) (Ferris Smith Reconstructive Surgery of the Head and Neck Thomas Nelson and Sons.)

FLAPS FROM DISTANCE WITH TUBED PEDICLE (Figs. 3, 4 7, 8 9 see also Figs 203 442) "Tubing of the pedicle" consists in suturing the raw edges of a long, rectangular pedicle, thus doing away with the

danger of infection by including the raw surface and furnishing a certain blood supply to a flap at its distal end

The depth of the outlining incisions—the included subcutaneous tissue—depends upon the size of the flap and its intended use Small tubes and flaps properly located those for covering of hands fingers the surface of the face and so forth require only a thin layer of subcutaneous fat below the derma An excellent example is the "pencil tube" raised along the superior surface of the clavicle for ear and nose repairs (Figs 19 305 397) Large tubes and flaps for reconstructions of the extremities large cervical coverings and the like, require the connective tissue to the level of the deep fascia to insure the blood supply as well as the required covering for tendon sheaths filling of soft tissue loss and so on

Several methods of closing the two triangular defects remaining at ends of the tube after its suture and that of its bed are available

Gillies accomplishes this with a mattress suture to close the apices of the two areas in the tube and bed and with simple interrupted sutures

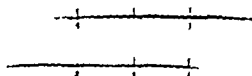


Fig 9 Davis and Kitlowski method of incision and tubing a pedicle

on either side (Fig. 4) This method has given the author satisfactory results in many instances over a period of years

Skin grafts to close this area are sometimes used One of the methods of suture described is usually sufficient

Davis and Kitlowski described a simple and effective incision which eliminates this triangle The parallel incisions are staggered so that the end on one side extends beyond the other 3 to 4 cm ($1\frac{3}{16}$ inch to $1\frac{5}{8}$ inch) The length of the parallel incision is reversed at the opposite end (Fig. 9)

Bunnell describes incisions which permit closure by suture and accomplishes two other things which he feels are desirable It produces three arms meeting at the angle instead of four as in the first procedure, it rotates the suture line in the pedicle outward from the closure of the bed of its origin He feels that "this insures against dampness and infection being reflected between them

The incisions and their management are pictured and described in Figure 10

The tube flap must be dry before closure and free from tension as it is closed The author prefers interrupted, simple suture to a "running" or subcutaneous stitch because this permits care of any local

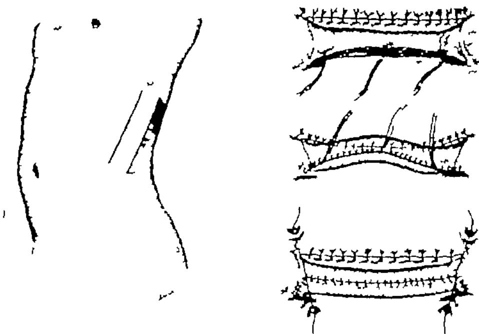


Fig. 10 Bunnell's method of incision and suturing for tubing a pedicle. See text (p. 9)



Fig. 11 Fig. 12

Fig. 11 Course and distribution of the thoraco-epigastric vein
Fig. 12. Thoraco-epigastric tube, Webster's method.

venous drainage An easily detectable substance is injected into the area to be tested its presence shortly in the general circulation indicates that blood is flowing through the area tested Further, the speed of absorption varies with the rate of blood flow In this way both a

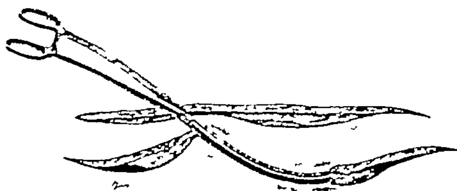


Fig. 13 Clamp applied to the unincised bridge of skin.



Fig. 14 Transabdominal tube. See text (p. 13)

qualitative and a quantitative estimation of the total blood flow arterial and venous can be made

Atropine which is easily obtainable and usable in small doses, produces three specific effects when it is present in these small amounts.

1 Tachycardia. The increased pulse rate is readily estimated and, if taken at intervals of five or ten minutes over a short period of time

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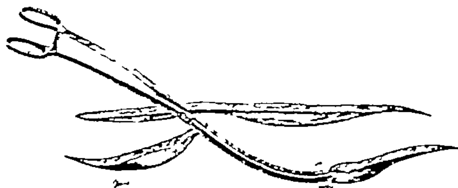


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Fig. 15 Total loss of lower lid. Use of forehead flap and tunneled pedicle containing temporal artery *Top* Outline of flap, *A* on distal end of the artery· the raw surface of this flap is grafted with mucous membrane *middle* incision, *B* in scalp *C* anterior temporal artery and vein enclosed in subcutaneous tissue· *D* (inset) cross section of pedicle, *C* *A* grafted scalp flap the forceps are inserted beneath the tunneled skin to grasp the flap, *A* and draw it into the defect, *bottom* completed repair

flaps with an artery and vein as a pedicle Monks modifi unham s procedure is useful in the repair of full thickness : lateral wall of the upper half of the nose This flap uses the ery and vein as a pedicle The anterior temporal artery may pedicle of a tunneled flap of hair bearing scalp to replace an his is only occasionally necessary, however It may also be



chment of a tubed pedicled flap transferred from the abdomen to the left wrist



n-covered tubed pedicled flap with arm utilized as a carrier sutured into the velar margin of the palatal defect

ı grafted forehead flap to reconstruct a lower eyelid and re ı-orbital soft tissues (Fig 20)

se, *source of blood supply*, is so located that the distal flap ansferred without undue twisting or tension of the tube ped h would jeopardize its viability The patient s comfort, dur- eriod of three weeks that the pedicle remains attached must ered (Figs. 6 7) *Perthe s method* of outlining dissecting and

resuturing the flap in its original bed to insure adequate blood supply is usually combined with this procedure

FLAPS TRANSFERRED ON CARRIER The arm is usually the carrier in this method. This is essentially the *Italian method* which was primarily

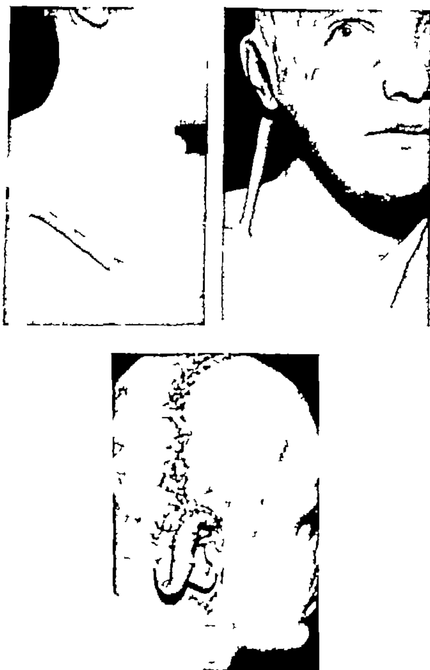


Fig. 18 Supraclavicular tube caterpillared to provide the helix of the ear

proposed for rhinoplasty It consists in fashioning a flap on the arm and later transferring it to the nose with the arm immobilized on the head until new blood supply is established

In the light of present knowledge the *original Italian method* has

They must be partially or totally raised from the surrounding tissue at intervals of two or three weeks until the blood supply is adequate when the pedicle is turned or twisted as required

The flap must be returned to its bed if there is the slightest evidence of ischemia. The flap in Figure 4 was elevated and delayed six times over a period of five months before it could be safely utilized.



Fig. 20 Loss of full thickness of nasal wall cadaver demonstration. *a* Full thickness defect in lateral wall of the nose line of frontalis artery and outline of a scalp flap on the distal end *b* Elevation of a scalp flap and the frontalis vessels. *c* Flap and vascular pedicle being drawn under the tunneled skin. *d* Completed repair (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

FLAPS OF CHOICE Cases of loss of full thickness of the cheek and adjacent lip permit a choice of procedure i.e. repair with bordering tissues or pedicled flap from a distance depending upon the area of loss and availability of adjacent skin

The lining may come from the borders of the defect, as required, either from the bordering mucosa or hinged flaps of marginal skin. The covering skin comes from the cheek borders and neck as an advanced,

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Do not graft unless the blood volume nonprotein nitrogen and endocrine and vitamin balance are satisfactory

Any of the various types of grafts will grow on all sorts of fresh wound surfaces and on healthy granulating bases. The wound surface may be any of the constituent soft parts, such as muscle fascia, perichondrium periosteum, and so on. The thinner the graft, the more certainly it will grow on areas of poor nourishment.

All grafts live as parasites by absorption of lymph until a new circulation of blood is organized.

Thin grafts of epithelium (Thiersch) will grow on bone and in the presence of infection.

The granulating surface to be covered should have a *zero bacterial count* It must be firm and must have a healthy reddish-pink color It is better to remove the granulating surface entirely This is readily done with a blunt surface such as a knife handle

The present scientific basis was established by Reverdin, followed by Ollier (1872) and Thiersch (1874) They used larger epidermal grafts and introduced present methods. Thiersch called attention to the necessity of thicker split grafts to counteract contraction. Wolfe used full thickness skin for grafts Krause used more of them—a 100 or more cases reported.

Staige Davis later introduced "small deep grafts" which are cone shaped with full thickness at the center

All grafts pigment—the split graft more so

The granulation bed—not the graft—contracts

Preparation of Bed. Numerous methods of preparing the bed are proposed. Wet dressings of saline or boric acid solution are useful. Infection which does not yield readily to this simple treatment, may be eradicated by the use of a dressing of *bacteriophage antibiotics peptone or chlorophyll* Compresses of *potassium permanganate* 1 1000 changed frequently may be required. *Sulfathiazole* dusted on the granular surface, *penicillin Furacin* or *phosphoric acid* usually will sterilize it promptly or inhibit bacterial growth.

Davis Method This method of preparation immediately before grafting is satisfactory The granulations are thoroughly cauterized with pure carbolic acid and removed down to a firm base, and the surface is dressed with gauze impregnated with sterile boric acid ointment. A bandage is firmly applied. The new granulations are ready for the transplant in twenty-four to forty-eight hours

Types of Grafts *Thiersch Graft* This includes all layers of the epithelium and the tops of the papillae in the corium. Growth of these grafts is practically certain if they are properly cut, applied and dressed. They will grow on bone, cartilage tendon and in the mouth in the presence of secretion as well as on granulation or a fresh tissue base

They should be applied on a dry surface They may be fixed in place by a dressing for a short period by a mechanical device (mouth) by spreading the graft over a mold and suturing the mold in a prepared

pocket (Esser inlay) or they may be applied to the raw surface protected by a frame covered with gauze and left exposed to the air (eyelid) Dressings on granulating surfaces should be opened on the second or third day for removal of secretions. The graft may then be dressed dry or exposed to the air

The *usefulness* of such grafts about the neck and face is limited. They are used to produce or increase the depth of a buccal sulcus or to line a prepared cavity for a prosthetic eye They are frequently essential for the closing of a burned surface. This graft will not control the *scar contraction* of granulating or organizing surfaces. It frequently acquires a pearly gray surface or becomes darkly pigmented and contracts. The epithelium of these grafts, in the mouth undergoes metaplastic change to suit it to its new environment.

Moszkowicz-Esser Waldron Epithelial Inlays A pocket, somewhat larger than the final area desired is made by dissection An impression of this cavity is made with sterile dental modeling compound. This model is covered with split skin, raw surface outward and inserted into the prepared pocket, after which the edges of the pocket are sutured together

Ten or twelve days later the wound is opened and the mold removed. The cavity is dried in the air or with the heat from an electric light bulb and the mold is reinserted without suture. This procedure is repeated for several days until the new skin is thoroughly organized.

These grafts, for producing or increasing the depth of the buccal sulcus may be held in place by a mold on a frame, which is attached to bands or splints fitted about the teeth or by adding required size to the buccal flange of a denture which is maintained in position by a Barton bandage.

"Split" Skin (Intermediate) Graft These grafts include all the epithelium and upper layers of the corium. They do not include sufficient elastic fibers to cause contraction They are cut ordinarily from 0 016 to 0 020 inch (0 04064 to 0 0508 cm) thick (Figs. 21–25) This added "body" gives a much wider range of usefulness than the Thiersch graft and satisfies all requirements except the prevention of contraction in deep granulating and scar beds. These grafts are indicated for *temporary* repair of subtotal losses of skin of the face, nose, ears and neck (burns), and for replacement of skin on all other parts of the body except areas in which tendons are exposed.

These grafts are cut in sheets of desired size to overlap the margins of the defect and are fixed in place with a running suture through the graft and the underlying marginal skin of the defect. Larger grafts are further fixed, with one or more such sutures passed through the skin and the bed of the defect. These are placed at intervals of an inch, running the length of the graft. Several "pie cuts" are made for serous drainage (see Fig. 580 p 838)

AUTHOR'S TECHNIC. The graft is covered with fine meshed gauze permeated with Furacin ointment. A layer of flat gauze sponges and fluffed

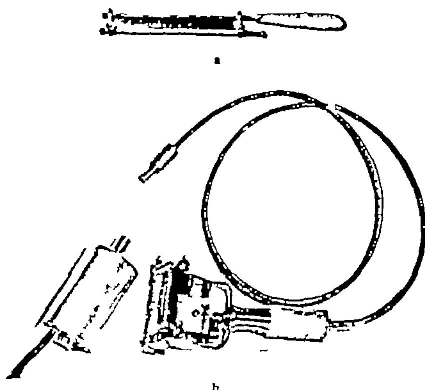


Fig. 21. *a*, Marck's knife, a free-hand knife with adjustable thickness guard for use with a feeler gauge. *b* Brown's dermatome, an accurately constructed, motor driven skin-cutting machine with micrometer adjustment, fine replaceable blades, used without any adhesive. It permits easy cutting of any skin surface.

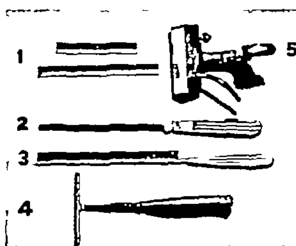


Fig. 22. Razors and traction instruments for the cutting of grafts. *1* and *2* Removable blades of different lengths and handle (Ferris Smith) *3* razor with a fixed blade (Blair) *4* sharp-toothed stretcher (Ferris Smith) *5* vacuum tractor for producing skin tension (Blair)

gauze is applied with a moderately firm Ace or Gauzetex bandage. The donor area is covered with fine gauze permeated with scarlet red ointment. This dressing is undisturbed for five or six days, if there are no

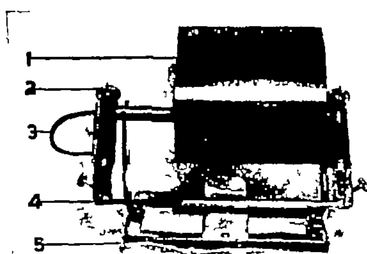


Fig. 23 Padgett's dermatome. *1* Drum, *2* knurled knob operating a micrometer adjusting screw; *3* handle for moving the knife to and fro longitudinally; *4* knife blade holder and knife *5* stand.



Fig. 24 Area on the back resulting from the removal of a single graft. *Inset* the graft on the drum at the completion of cutting.

indications for removing it. The layer of Furacin gauze is not disturbed if the graft is dry and in proper condition. A fresh dressing of gauze is applied over it.

The stitches are removed on the eighth or tenth day and the graft is dried in air and re-covered with a light dressing. It is left exposed to

the air on the fifteenth day and coated with oil such as is used in the nursery If drainage occurs, the graft is immediately dressed with gauze sponges wet with saline solution. Such a dressing for the initial two or three days is preferred by some surgeons.

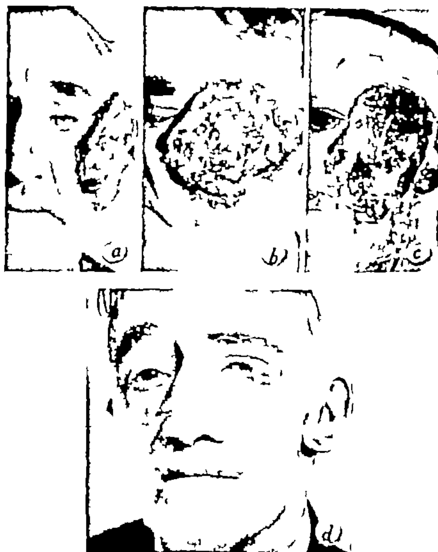


Fig. 25 *a* and *b* Basal cell carcinoma of the face *c* the defect after destruction of the carcinoma *d* six years later the appearance of a single split skin graft covering the defective area *the paralyzed eyelids support each other by a surgical* adhesion between them at the outer and middle thirds.

Reverdin (Pinch) Grafts (Figs. 26 27) These grafts have *no place in the surgery of the face and neck* In fact, they no longer have any proper place in modern surgery They have served to assist in covering raw surfaces but they can neither prevent scar contraction nor

produce an acceptable cosmetic result. The "split" graft is more readily obtained, more easily applied and dressed, and it produces a far superior result.



Fig. 26. Reverdin or "pinch" grafts, Wolfe graft a, Area of removal of pinch grafts, b appearance of grafts after organization.

Wolfe (Full Thickness) Grafts (Fig. 28) These are the *grafts of choice* in most instances for replacing *full thickness skin losses* of the face and neck for replacing skin loss of the eyelids (ectropion and so

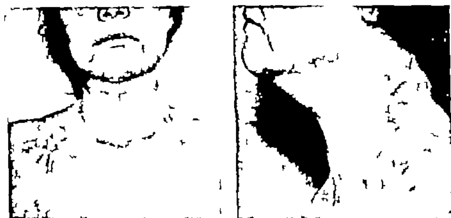


Fig. 27 Patient presenting Reverdin (pinch) grafts on the shoulders Wolfe (full thickness) graft on the chest and at the base of the neck; a pedicled flap graft covering the neck. This replaced a large number of contracted pinch grafts.

forth) or of the nose and so on. *Grafting is not the procedure of choice for these losses but frequently one of necessity*

They are grown with great certainty when all the required conditions

are complied with. It is obvious that this graft is a parasite existing on absorption of lymph during the first two or three days Hence its intercellular spaces must be open to the absorption of lymph in order that nourishment may reach its cellular elements. Whole blood cannot accomplish this requirement, and collection of blood beneath a graft causes it to perish.

The graft must be cut accurately to the *size of the defect* to be filled. For the same reason, the graft must be *accurately approximated* by carefully placed sutures. The entrance of lymph from its circumference and the early ingrowth of vessels around this border are big factors in successful nourishment. The graft must be *free from fat* for obvious reasons. The graft must be *accurately approximated to its base by a*



Fig. 28 a, Skin under normal tension, b contracted skin. Note that the subepithelial tissues lie in somewhat parallel bundles in the skin under normal tension and that the basement membrane is practically horizontal. Compare with the contracted skin. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

proper even pressure The "proper" pressure—the one which produces the maximal supply of lymph in the area—is approximately 30 mm. of mercury This may be accurately gauged by incorporating a specially designed, flat rubber bag or the arm cuff of a blood pressure manometer in a rigid dressing (plaster) and inflating to this point on the scale of the pressure machine. The tube to the bag is clamped and not disturbed until the dressing is removed (twelve days) The surgeon with experience can gauge the bandage pressure with a fair degree of accuracy but his percentage of success is less than when the controlled method is used. Finally the part should be *immobilized for twelve days*

The graft has a well-established blood supply at this time (twelve days—not sooner as a rule) Motion will destroy the lymph adhesion of the graft to the bed and disturb the formation of new circulation at the borders and the base

The walls of the young vessels collapse when pressure is removed sooner A flap which appears splendid when the dressing is removed on the tenth day frequently becomes cyanosed and dies. The graft presents a pinkish-white color when its condition is ideal. Occasionally areas are found in which the surface epithelium is separating from a corium which is in a healthy growing condition This area is kept dry until it separates The epithelial layers usually regenerate

The graft is redressed with moderate pressure for several days before exposure to the air It is then oiled until its epithelial surface is well organized The various types of wet dressings metal foils powders, and so forth are in no wise essential to the growth of the grafts.



Fig. 29 *a* Pressure-bag dressing on a Wolfe or full thickness graft, *b* appearance of the graft immediately on removal of the pressure dressing (1_ days)

Homologous Grafts. Homograft, homologous graft and isograft are synonymous terms indicating tissue transplanted from one to another person of the same species.

Experience and more accurate observation hav- definitely dissipated the old belief that such grafts and zoografts may be permanently suc cessful The only reliable reports of success have been in cases of monozygotic twins.

Certain groups, in more recent years, have believed that homografts should be applied as emergency dressing to burned patients who suffer increasing debility from fluid loss and pain despite apparently adequate supportive measures. Such patients are unfortunately frequently pre sented for care They arrive in a chronic state characterized by severely reduced blood volume and progressive anemia. Parenteral and oral hydrolysates and electrolytes in conjunction with large quantities of whole blood almost invariably correct the contracted blood volume Effective wound care during the interval and favorable response usually permit successful skin grafting in a week to ten days. *A patient who sur*

vives the initial and secondary shock of his injury should safely withstand the procedures necessary to replace his skin loss with autografts

There are however rare instances of patients whose condition has become so extreme through either uncontrollable circumstances or neglect, that homografting is vital in halting the constant body fluid



Fig. 30 Extensive homograft. See text (p. 27)

loss and permitting restoration of the loss which has occurred. This is strikingly evident when the injury is so extensive and so distributed that an insufficient amount of skin is immediately available for autografting.

Choice of homografting demands critical consideration of the following facts These grafts grow well but survive only three to ten weeks donors may be selected regardless of blood grouping or consanguinity race or sex specific antibody response prevents a second growth of skin from a given donor severe reactions may occur rarely from host

sensitivity to donor proteins most grafted areas must be replaced ultimately with autografts.

The author is indebted to his associate, F J McCoy for a critical appraisal of this question and a strikingly extreme example of its value in his hands (see Fig. 30) Homografting was a "procedure of necessity" in this case

Case 1 A soldier aged twenty-six years suffered second and third degree gasoline burns of 60 per cent of his body surface, cerebral concussion and compound fracture of his left tibia and fibula in a motorcycle-jeep accident. He had supportive treatment for shock and concussion refrigeration and sympathetic blocks for cold, cyanosed, pulseless leg; débridement and guillotine amputation twenty-one days after the accident. Total proteins were 4.7 hematocrit, 31 and red blood count, 3.28 on the twenty-fifth day

The patient was admitted to McCoy's service on the forty fourth day He had a malodorous drainage and heavy maggot infestation chest pain with atelectasis of the right lower lobe. He was given whole blood and plasma, and put in shock position, and oxygen administered. There was a slight response to therapy in two days.

Only two drums of skin were available on the upper back, consequently sixteen donors were chosen on the eighth day to give twenty-three drums of skin (736 sq inches) The entire procedure required six hours and fifty minutes of anesthesia.

The patient's response was dramatic. His temperature was normal with a corresponding pulse rate in seventy-two hours. He had an increasing appetite and improved morale.

The administration of whole blood and plasma continued. The first dressing on the sixth day showed a 90 per cent growth.

The patient was again transferred to another hospital where only supportive treatment was required. Resolution was practically completed in eight weeks and autografting begun.

Refrigerated Grafts. There is considerable discussion of the value of refrigerated skin— banks" like blood banks—which is largely theory with nothing factual or clinically sensible to support it. There are however several sound reasons for refrigerating autogenous skin for limited periods and for certain purposes.

Wencher first used such free autografts in 1904 One such graft seven days old and two out of three fourteen days old succeeded.

Webster in an excellent report of his observations on twenty-three patients with such grafts on thirty six occasions beginning in 1932, arrives at the sound conclusions which should guide the careful surgeon. He is dealing with "split" skin Brown and McDonnell reported the successful use, forty-eight hours after removal of a full thickness refrigerated graft from the neck

These are Webster's reasons for refrigeration and later use of *autogenous* grafts. They have also been our experience for a long period

1 The patient s condition may become such that it is unwise to continue beyond the taking of the graft. This may be refrigerated and applied later when the situation has improved A life-saving decision

2. Whenever graft in excess of the requirement has been taken, the surplus may be refrigerated for replacement, if any part of the applied graft fails.

3 *Enough graft may be taken under one anesthetic to preclude an*other or at most, very brief succeeding anesthesia.

4 Skin may be removed at a minor procedure such as removal of eschar for use at a major later one It may then be applied with a brief anesthetic, a local in the skin borders or none at all

There is rarely any sense in preparing homologous skin from cadavers, amputated legs, and so forth for temporary dressings because such skin is invariably obtainable Its use is occasionally vital, but always temporary

Further there is a constant change in structure and chemistry of skin under refrigeration by present methods. The chemical change can be prevented only by constant temperature of —40 F and careful wrapping Webster reported that all his autografts refrigerated longer than three weeks "melted away" He describes an excellent method of preparation.

We have folded our skin in fine mesh gauze impregnated with petrolatum and stored at —35 F until use ten to fifteen days later The results have been gratifying.

Tattooing of Grafts and Flaps. Skin color results from pigment and the blood flow in its capillary bed. Some skins and some areas of the body present little objective evidence of either Pigment is the principal factor in the face, neck and other small body surfaces. The blood flow produces the red element in its color This is lost in a free graft until a new blood supply is established. This is as a rule, inadequate for desirable red color restoration.

This is less true in a pedicled flap The rotated interpolated flap from the face and neck presents little if any change The former flap maintains, to a large degree the color of its source. Free full thickness grafts from the mesial surface of the ear and surrounding hairless skin and the eyelids show little change in most instances. The free graft from other areas becomes gray white yellow or brown from loss or condensation of pigment.

Cosmetics are necessary to hide a feature which in many cases, is grotesque. The grafted upper and lower lips produce a clownlike appearance Cosmetics are not acceptable to men. They cover and change the disability for women in most cases, but the necessary type is not acceptable

Tattooing, rather than re-operation to eliminate the graft or flap is desirable in rare cases.

The pigments must be *unaffected by the body chemistry insoluble* and nonpoisonous. The color blending of the various salts and oxides to obtain an acceptable cosmetic result requires a keen color sense artistic ability and meticulous technical performance

The procedure is painful. Pain may be prevented with barbiturates and/or novocain blocking. The skin is scrupulously prepared with soap water and alcohol or ether The pigment and instruments are autoclaved.

Pigments are mixed to a creamy consistency with saline solution A thin coat is spread over the abnormal area to judge the matching The mixture is altered much as a painter blends colors on the palette until the desired shade is obtained

Professionals use multiple vibrating needles. This method is essential in large areas. Needles on a fixed base are best until one has considerable experience. The needle points carry the pigments obliquely into the derma. The pricks should be very close together

This pigment blends, diffuses and blanches somewhat with the passage of time. It is often necessary to treat again the patchy areas which appear

The treatment creates a severe inflammation for ten days followed by desquamation Dense scar tissue makes the needling difficult and limits the diffusion of pigment. It is better begun when the graft has attained maximum organization.

It results in definite cosmetic improvement, but is rarely necessary when the planning has resulted in reconstructive procedures of choice

Skillful tattooing of white corneal scar is very desirable. Pickrell reports some excellent results

Lining Tissues. Lining tissue for the cheeks lips, nose and occasionally for the eyelids is supplied by skin introduced either as a hinged rotated tunneled or pedicled flap or as a free graft variously applied The free graft may be applied to the covering flap before it is transferred from its origin or on a temporary prosthesis which is either sutured (Esser inlay) in position or retained mechanically by a device or dressing.

The lining tissue for an eyelid is preferably obtained from another eyelid or from the buccal mucosa The use of thin skin is sometimes a necessity The epithelium undergoes metaplastic changes adapting it to its new environment.

The lining tissue of a lip is best provided with a rotated, interpolated flap of buccal mucosa in the manner described by Neal Owen (Cheiloplasty p 645 Fig. 439)

Cutting of Grafts. *Split grafts* are cut "free hand" with *any sharp knife* or razor of proper length. Special razors with either fixed or removable blades of varying lengths are available Those with removable blades are more likely to be sharp when needed (Figs 21 22, 23)

The skin is smeared with a thin film of sterile petrolatum held flat and tense with two sterile boards, the straight edge of a rectangular basin with stretcher hooks designed for the purpose or with vacuum cups (Blair) The razor is engaged and moved with a to-and-fro sawing motion until the desired graft is completely cut. The graft should be transferred to its bed immediately

Grafts are cut mechanically with the *Padgett dermatome* This device permits one to cut a sheet of skin of any size up to 4 by 7¾ inches (about 10 by 19 cm) and of uniform thickness. The skin may be removed from any part of the body some parts of which are not suitable

for use of a razor (inside of thigh, middle of the back, and so forth) The calibration of the knife supports permits cutting grafts of any desired thickness available in a particular skin (Figs 21 *a* 21 *b* 23) This is possible with a Marck's knife, pictured in Figure 21 *a* These devices will not be available always The surgeon must be prepared to obtain skin in the ordinary manner (razor)

The raw surfaces created by the removal of "split" or shaved skin are dressed with scarlet red ointment gauze. They are untouched until healing is complete

Full thickness grafts are removed from the arm or the inside of the thigh to cover hairless areas and from any part of the body for other use They are usually removed from the abdomen because closure of the defect is easy The graft is outlined dissected free from fat, and immediately transferred to the prepared bed. The defect is closed by undermining its borders and suturing, grafting or by transfer of suitable flaps.

Mucous membrane grafts are obtained from the lower lip the buccal mucosa the covering of a section of middle turbinate bone or from the conjunctiva. They are managed in the same manner as skin.

BONE, ONE OF THE SUPPORTING TISSUES

The loss of bone or its fixed displacement with functional and/or cosmetic disability may be corrected in several ways.

Bone Transplants Their Regeneration

About the *source* of bone regeneration there is a marked difference of opinion which is based upon numerous careful researches through a period of years on the one hand and fewer similar researches and much clinical evidence more recently on the other The first group believes that grafted periosteal covered total bone offers the sole possibility of regeneration while the latter believe that metaplasia is the principal process.

MacEwen disputes the osteogenetic influence of periosteum. He states that the bone cells change to osteoblasts. Murphy states that the regenerative cells are osteogenetic cells of the capillaries growing from the living bone—the graft is osteoconductive rather than osteogenetic. Geddes maintains that periosteum is far from an osteogenetic membrane.

Another group of researchers and reporters believing that bone regeneration is a metaplastic process are Murray Bier Leriche and Policard Petrow and others. They believe that penetrating fibrous tissue cells are converted into bone cells. They do not believe that the inclusion of the periosteum is necessary

An excellent, thorough review of this consideration, based on the literature and personal research, was reported by May in 1936 Our experience which is largely clinical, is the basis of the following discussion. Anything further than obtaining a desirable clinical result in

a most certain manner is beyond the purpose of this text. An acceptable knowledge of the process of changing transplanted bone into living bone is essential, however to the choice of technique and its successful after-care

Transplanted Cancellous or Spongy Bone. MacEwen Phemister Mc Williams and Keith observed that small pieces of grafted cortex survived. Further Lexer Mattl, Henderson McGaw and Harbin believe that spongy bone cut in small pieces lives because its loose structure has early blood and lymph supply They considered periosteal covering essential.

Transplanted Cancellous Bone Chips. Mowlen reports and discusses seventy-five cases, all successful despite several potential infections These included several areas of bone loss with altered contour where fixation was not required, such as the frontal supra-orbital, malar zygomatic and mental regions

The initial case was a loss in the frontal bone of a child eleven years old He believed that a considerable reported successful experience with blocks of cancellous bone from the ilium resulted from an early vascularization and cellular activity This was demonstrated by structural adaptation and a new cortex in eight to ten weeks and the relative high tolerance of infection. It was decided that fragmentation rather than a block, provided a greater surface area for early nourishment by serum and the later invasion of new capillaries with increased chance of survival. These fragments were approximately 1 by 0.5 by 0.2 cm in size They were inserted through a small scalp incision, after curetting the margins of the defect and arranged in layers with no overlapping of the chip margins. The wound was closed without drainage The mass organized firmly No absorption was demonstrable after three years.

Similar chips were used in thirty four cases to restore contour of the skull and facial bones. A complete bony foundation is not available in some losses such as those in the superior maxilla.

Two or three freshened bone areas are adequate for fixation The grafts do not depend for survival on the bordering bone but rather upon the blood supply

The successful treatment of thirty-six mandibular defects varying from ¼ inch to 2 inches and five extensive defects in long bones by this method are included in this report. A "distance piece" of cancellous bone ¹⁄₁₆ to ⅛ inch in thickness and required length is placed upon the mesial aspect of the mandibular ends, and a similar piece in losses of the long bones. The bone chips are placed in the defect against these strips. They are *guides* or *formers*' around and between which the bone contour is built up with chips.

Blocker after a generous and satisfactory experience maintains that blocks of iliac cancellous bone are the choice of procedure. These are fitted as a combined inlay and "onlay" He uses the chips resulting from the preparation of the block to supplement it and add to the contour

These are shaped and maintained by a perforated tantalum tray in large defects of the mandible—angle to angle or less—which is removed after eight to fourteen weeks. The results, after meticulous preparation and postoperative care, justify his conclusions as applied to the mandible, the nose and some full thickness losses of the skull. It is our experience and conviction that small (0 1 to 0.3 cm.) particles ("meal") offer better possibilities of growth and cosmetic result in some of the contour disabilities of the maxilla, frontal zygoma, and so on. The organization depends upon vascularization rather than upon the bordering bone. *This increases in proportion to the exposed surfaces.* We believe that the osteogenesis results from metaplastic changes in cells originating from undifferentiated connective tissue.

Further we are of the opinion that the substitution of tantalum plates and the like for bone of this type or proper osteoperiosteal implants in the repair of large skull defects is a mistake e g. this substitution of a foreign body We have never seen and do not believe that it occurs, any late irritation from such reconstruction in the presence of intact meningeal covering.

Bone: Structure and Replacement

Bone has two constant, permanent elements specialized cells (osteocytes) and an intercellar material consisting of *fibrils* and a calcified *cementing substance*

Two types of cells appear during active destruction and regeneration. These are *transient* elements and are called *osteoblasts* and *osteoclasts* Some of the osteoblasts become enclosed in the fibril formation-calcification process and become osteocytes. There is no mitosis of these cells.

Both the osteoblasts and osteoclasts develop from undifferentiated mesenchymal cells or reticular tissue.

There are several theories as to the cause of this differentiation of the connective tissue cells

1 Adjacent undifferentiated connective tissue (about the surface of the bone) is stimulated by chemical change
2. A pressure change
3 Action of blood elements or tissue fluids.

Growth *always* occurs by the addition of new bone to free bone surfaces—apposition. There is no interstitial bone growth

Bone Grafts

Ollier stated in 1867 that bone transplantation is only possible with living, autogenous bone and that all other such tissue is a foreign body This was based upon clinical and not microscopic observation

Barth stated in 1893 after careful experiment, that all elements of transplanted bone die and are replaced by new bone from the adjacent tissues.

A group of able observers have contended that some element of the transplant survives and is capable of osteogenesis.

Homogenous and Autogenous Grafts. Homogenous bone transplantation was first successfully performed by McEwen in 1880 The successful use of such bone preserved by freezing was reported by Carrel in 1912. Lexer Gill and May reported successful transplants in subsequent years.

It has been the generally accepted belief and that of the author that no homologous tissue other than lymph-nourished tissue, such as cornea and cartilage, could be transplanted and exist as such The preceding reports of clinical success with homogenous bone variously prepared and the more recently aroused and successful interest in bone banks appeared to refute this belief Homologous skin grows and is absorbed. There is no regeneration of skin structure It has seemed certain that implanted homologous bone must act as a prosthesis and, perhaps a catalyzer

A recently concluded carefully planned and excellently conducted research by Reynolds and Oliver not only substantiates our belief as to the fate of homogenous tissue, establishes its value as a stimulating prosthesis and gives it a place equal to autogenous tissue in a reconstruction but definitely establishes the behavior and fate of autogenous implants.

The purpose of this research was to re-evaluate the present concepts of the behavior of bone grafts and regeneration as well as to compare critically under identical conditions, autogenous and the various types of homogenous bone grafts.

The experimental procedure conformed to three essential conditions

1 Extrinsic factors such as immobilization, graft bed and vascularization were uniform.

2 A simple positive method of comparing the grafts with surrounding normal bone as a control in the same section was used.

3 A similar method permitting comparison of the different types of homogenous grafts and normal autogenous bone under identical conditions was used

Group I—Ten Animals PROCEDURE

1 An area of the proximal tibia, 1 inch (2.5 cm) from the tuberosity was exposed on each leg.

2 The periosteum was incised longitudinally and elevated.

3 A rectangular block of cortical bone 1 inch (2 5 cm.) by ⅜ inch (1 cm.) was removed with a motor saw on the medial surface of each tibia.

4 The proximal half of the excised area on the left side was filled with autogenous bone removed from the right side the balance was filled with fitted bone from the merthiolate bank. The excised area on the right tibia was similarly filled with autogenous bone from the left side and frozen (−20 C) homogenous bone

Merthiolate bone is prepared by immersion in 1 1000 aqueous merthiolate for two weeks and a 1 5000 solution thereafter

Group II—Six Animals Single grafts of cortical merthiolate bone

filled the left side and autogenous bone from the left filled the right side.

Group III—Six Animals Homogenous boiled bone (boiled ten minutes and kept under sterile conditions) filled the left side, and contra lateral autogenous bone the right side

The grafts were all fitted as tightly as possible. The periosteum was not repaired Soft tissues were closed in layers. An animal was killed and specimens were removed each week. These were fixed in formalin and decalcified.

The following factors of healing formed the comparisons between the autogenous and various homogenous grafts

1 *Hematoma* occurring in the marrow beneath the graft Its organization occurred at a uniform rate and manner in all specimens.

2. Proliferation of osteoid tissue followed immediately the organization of the hematoma Some factor probably the chemical result of the osteoclysis occurring in the graft, stimulated the young, undifferentiated mesenchymal cells to become bone-producing cells (osteoblasts) This occurred on the periphery of the hematoma and on the endosteal surface of the graft.

This is the beginning of the host healing process.

The trabeculae occurred in equal amounts in all sections at the end of the first week and proceeded uniformly during the succeeding weeks. Bone cells were eventually deposited on the endosteal graft surface and the graft junctions The osteoid production was completed *in all types* in about five weeks.

3 Appositional bone growth. This is the addition of new bone to free bone surfaces and is the process that always occurs. There is no interstitial growth. This process involved the entire free surfaces of all grafts in four weeks, except the boiled bone where it was not evident until the sixth week.

It appeared only slightly earlier in the autogenous than in the frozen and merthiolate preserved grafts.

It appears certain that this appositional growth is a healing process of the host and is not related to the type of graft.

4 Osteoclysis. The changes in bone result from physiologic destruction and *new* formation. This is found in the adult body wherever reconstructive processes of bone occur (It is recommended that the reader see the excellent microphotographs and discussion of Weinmann and Sicher also of Arey)

5 Union of grafts This resulted from the processes already discussed. It had occurred in all grafts except the boiled bone in four weeks and was evident in the latter at the end of six weeks.

The junction becomes visibly extinct by the end of the eighth week.

6 Haversian canals. Vascularization of these canals results from the ingrowth of capillaries from the host tissue into these structures.

In these experiments this began first in the inner aspect of the grafts closest to the richly vascular host tissue

7 Remodeling of the bone This follows fixation of the graft and

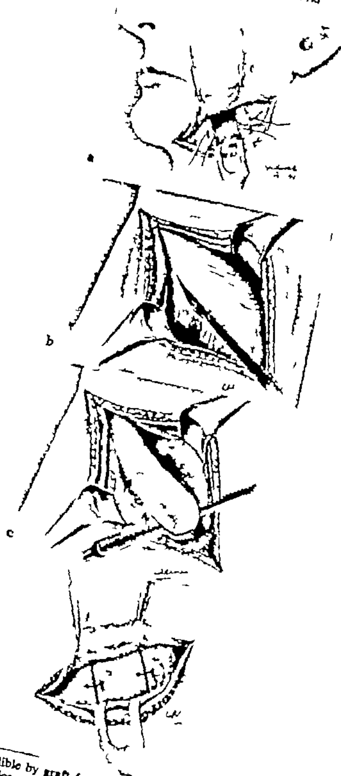


Fig. 35 Repair of mandible by graft from crest of ilium. *a* Preparation of site, wires in position for insertion of graft, *b* exposure of crest of ilium *c* removal of graft with metacarpal saw D graft inserted.

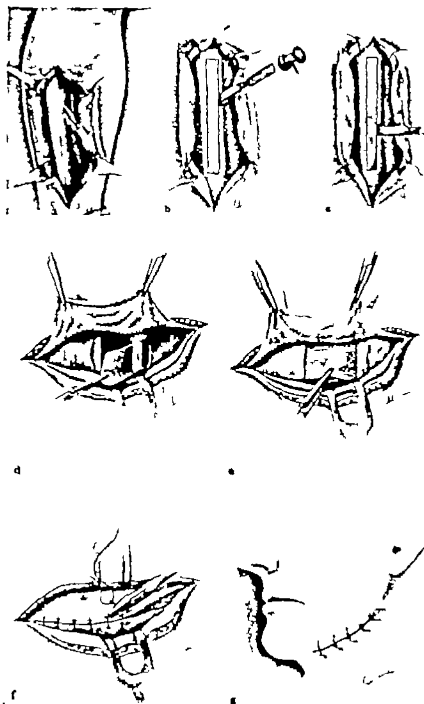


Fig. 34 Osteoperiosteal method of bone graft for repair of mandible. *a*, Exposure of tibia outlining incision for the graft through the periosteum *b* outlining incision carried into the bone with broad, thin chisel *c* removal of graft with chisel *d* and *e* insertion of graft, periosteum outward, *f* closing deep tissues with interrupted catgut sutures *g* skin flaps closed with fine sutures.

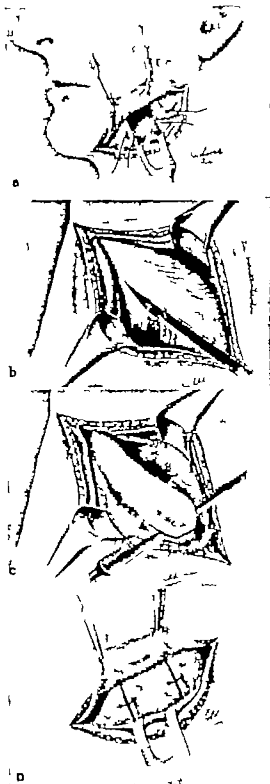


Fig. 35 Repair of mandible by graft from crest of ilium. *a*, Preparation of site, wires in position for insertion of graft *b* exposure of crest of ilium, c removal of graft with metacarpal saw· D graft inserted.

Chapter II

CLEFTS AND FRACTURES OF THE FACE

CONGENITAL CLEFTS OF THE FACE, LIP AND PALATE

These result from failure of fusion of the involved supporting framework and soft tissues. The etiological factors are not recognized. Tendency to the defect is hereditary in less than a majority of the cases. The clefts of the face, the lateral sides of the nose, the lids, and so forth are comparatively rare. They are better managed by the application of basic principles to the existing fusion defects and maldevelopments in the individual case than by any stereotyped procedure.

The common clefts are those involving the lip, the alveolar process and the hard and the soft palates. These may be classified here according to the surgical requirements for their reconstruction.

1. *Cleft or hare lip*, unilateral or bilateral, is classified as complete or incomplete, depending on the involvement of the floor of the nostril. The degree of cleft lip varies from a notch in the vermilion border to complete separation of all soft structures up to the floor of the nose. Clefts occur most frequently on the left side. Median clefts are rare.

2. *Clefts posterior to the alveolar process* may involve various parts of either the hard or soft palate, or may be complete from the anterior palatine foramen to the uvula. The latter cleft may be bilateral or unilateral, depending upon whether the vomer hangs unattached to the palatine processes or is attached to the palatine process on one side.

3. *Clefts of the alveolar process* usually include the lip and the pos

tenor palatal structures. The palatal cleft may be of either type noted in group 2. The bilateral alveolar cleft isolates the premaxilla and prolabium This is ordinarily displaced forward and frequently upward. It may also be rotated laterally

The proper surgical reconstruction of these lip and palate defects has suffered the same slow painful evolution as numerous other procedures. The cosmetic failures in lips have resulted from a lack of proper appreciation of scar formation and its ultimate contraction the utilization of this certain contractile traction to produce a desired form and a management of the nose to produce a normal floor and shape to the nostril There still remain different and desirable accomplishments in the restoration of the premaxilla in many cases, a more satisfactory construction of the bilateral lip and a better disposition of the prolabium and the tip of the nose

Le Mesurier has recently revived and popularized a simple, basically sound technic utilizing these factors in the correction of the unilateral cleft. It was originally described in principle by Hagedorn (see Fig 446) The surgeon's responsibility is again a dual one, in which the technical demands are much greater cosmetically than functionally The ultimate should be a lip and nostrils and a functioning nose that are approximately normal

The evolution of a good palate reconstruction presents a similar story with more marked controversy and failure to appreciate the involved anatomy and physiology The failure to understand the blood supply of the palatal bones and the consequent dissection of the soft covering above its periosteum accounted largely for the many failures prior to von Langenbeck a century ago Diffenbach (1826–1828) and many other surgeons utilized this flap Langenbeck (1861) advocated the median approximation of lateral double-pedicled flaps supplied by the anterior and posterior palatine arteries. He included the periosteum in the flaps to insure their blood supply despite the universal belief that this would result in necrosis of the bone He later (1862) carried the dissection beyond the posterior margin of the palate bone and sectioned the nasal mucosa at the bone edge to increase the velar length and aid its approximation. He also sectioned the levator and palatopharyngeus muscles to relax the velum.

Passavant called attention at this time (1862) to the persistent nasal twang in closed palates with a resultant short velum He described several operations to correct this

Successful closure but not part of the desired function became more certain after Langenbeck's contributions. About 1871 real interest in better function began Two things demanded consideration first, the closure of the oral and nasal cavities and second, a functioning velar pharyngeal valve to permit proper speech

Tait (1870) extended the lateral incisions over the alveolar ridge whenever necessary to gain greater width of flaps in wide clefts He recognized the importance of the tensor palati muscles to successful staphylorrhaphy condemned the extensive muscle resections of Fer

guson, but sectioned the palatoglossus and palatopharyngeus muscles in the effort to improve function

Billroth (1889) attributed the many functional failures to failure of this action of the velum and upper pharynx. He condemned lateral incisions in the velum and advised section with a chisel of the hamular process through the posterior ends of the lateral incisions to reposition the pull of the tensor muscles. Many operators in the next few years sectioned velar muscles

Gillies and Fry maintained (1921) that closure of the entire palate the hard palate particularly produced shortening of the velum and undesirable distortion of the mouth, nose and face. They performed staphylorrhaphy alone and closed the opening in the hard palate with an obturator The velum was separated with transverse incisions along the palate and the bone was covered with either split skin graft or with mucoperiosteum from the hard palate included with the velum

This combination of prosthesis and surgery destroys the insertion of some palatal muscles. It is impractical in children because of the constant developmental contour and dental changes.

Veau analyzed the anatomical and functional results of staphylorrhaphy in 1922, reported an excellent anatomical study of palatal and related pharyngeal anatomy and presented a sound, new technic utilizing these anatomical and physiological facts and generally recognized basic surgical principles. He differed entirely from the Langenbeck procedure He criticized the flattening of the vault the creation of a large easily infected dead space and the large scar formation with final contraction and shortening of the velum. He considered these things as main causes of undesirable surgical and functional results.

His technic is based on sound surgical principles and objectives He elevates and displaces medially flaps of mucoperiosteum with a single posterior base, separates the superior constrictor muscles and velum along the mesial faces of the internal pterygoid plates, frees and sutures the nasal mucosa, anchor sutures the palatal flaps to the nasal mucosa fractures the hamular process, approximates all layers of the velum and relaxes the palatal and superior constrictor muscles with a wire suture passed in velar muscles and twisted (fixed) in the original lateral incisions. These and other monumental contributions have gained international recognition.

Dorrance Operation. Dorrance described (1925) a "push back" operation to lengthen and relax the velum.

Objective To produce the palatopharyngeal sphincter action with the superior constrictors and the velar muscles It consists in *freeing* the mucoperiosteum by a semicircular incision around the alveolar border freeing of the velar attachment to the palate, closure of the velar cleft, and section and displacement of the hamular processes He pointed out that the tensors, hooked round the hamular processes, form two sides of a right-angled triangle and that when the bone is displaced medially the tensor is lengthened to form the hypotenuse of the triangle It then acts with the levator to produce elevation

Indications (1) All cases in which the velum is not adequately lengthened by the Langenbeck type of procedure (2) second operation in case of short velum (3) congenital insufficiency of the velum.

He described (1931–1932) the palatal insertion of the superior constrictor in the aponeurosis at the site of insertion of the levator palati. It is the traction of this muscle bundle together with the pharyngeal contraction of the balance of the muscle and the velar muscles that produces the "palato-pharyngeal sphincter" during speech and deglutition.

The operation is performed in two stages three months apart.

Procedure· STAGE 1 A U-shaped incision is begun posterior to the tuberosity and carried round the alveolar margin to a similar point in the opposite side. The mucoperiosteum is elevated to the palatal aponeurosis, and the palatine arteries are ligated. The flap is sutured in its normal position for three months If the original blood supply is questionable the lateral incisions are carried to the anterior palatine foramina and the intervening tissue is incised during the second stage.

STAGE 2 The original flap is elevated, the palatal aponeurosis and nasal mucosa are freed from the posterior palatine border and the hamular processes are sectioned The borders of the cleft are pared and a Veau wire suture is passed in the velar musculature. The nasal mucous membrane is sutured separately after which the wire suture is fixed by twisting. The oral mucosa is sutured then and the anterior end of the palatal flap is fixed to the denuded bone with a wire suture passed through it. A further support is provided by an iodoform gauze pack placed under a silver wire passed behind a molar tooth then across the palate behind a similar tooth on this side and the two ends carried round the dental arch to be twisted in front of the incisor teeth

Dorrance has published an exhaustive review and analysis of the evolution of cleft palate surgery This excellent text is commended to the reader

Wardill (1928) reviewed the results of cleft palate surgery in a lecture delivered at the Royal College of Surgeons. He pointed out the obvious objective of such surgery (1) to produce a division or closure between the oral and nasal cavities, and (2) to restore speech to normal or in infants, to enable them to speak properly at the right age. He stated, further that the operations generally performed had been practised for 100 years with some modifications of technic but none in principle. Finally he declared that the first objective—closure—was achieved with a high percentage of success by skilled operators regardless of the type of their procedure, but that the second purpose—*restoration of normal speech*—presented an equally high percentage of poor results. Few patients, out of the large numbers of operative cases, ever had normal speech restored. He made some observations common in the experience of all who are interested in this procedure that many people with cleft palates who have had no operation, speak surprisingly well that those who spoke badly before operation usually continue the

same speech afterward and conversely that the patient who speaks well after operation usually did so before.

Wardill discussed the basic requirements of the surgical problem and pointed out that no operation then proposed forms a sphincter with certainty in each case

Complete nasopharyngeal occlusion i e., a "cold in head" is less disastrous than inability to occlude (cleft) All consonants require complete occlusion except *m* *n* and *g* Such efficiency is not necessary for vowels.

Wardill discussed speech anatomy related to the palate The nasopharyngeal valve closes and opens many times per second in rapid speech. It has two main parts —palatal and pharyngeal.

A. Palatal, two muscle groups with opposing function
  - I. Abductors
    - (*a*) Palatopharyngei
    - (*b*) Palatoglossi
    - (*c*) Tensors
  - II Adductors—composed entirely of the levators

B Pharyngeal consisting of extremely complex muscle Its ramifications not adequately described
  - I. Those with practical bearing
    - (*a*) Superior constrictors
      1 Passavant s ridge transversely across the pharynx is a fasciculus of the superior constrictor muscle entering the side of the palate lateral to the levator mesial to the internal pterygoid plate, and attaching to the palatine aponeurosis Its contraction pulls the palate posteriorly and makes this pharynx ridge

        In the resting state the posterior edge of the palate hangs down parallel to the pharynx and is separated by a small anterior posterior space but a wide side to side (lateral) one The square or cross section area is fairly large. This space is alternately opened and closed during speech, but the muscles concerned make only small excursions. *A slight alteration* in the anterior posterior measurement makes a considerable difference in the total cross section area.

Wardill Operation. This must consider and make probable this normal anatomical behavior during speech.

The superior constrictor muscle contracts and elevates Passavant's ridge. This narrows the space anteroposteriorly and from side to side. The muscle remains contracted during speech. It forms a cushion against which the palate can flap It forms a "valve seat" for the superior surface of the palate Contact is at the level of the anterior arch of the atlas

It is impossible to judge the palate position by oral examination because this contact is hidden from view A deficiency of a few millimeters between the palate and its "seat" cannot possibly be appreciated.

Anatomical Defect There are two great changes defects in (1) the soft parts and (2) in the skull bones

1 Soft parts

(*a*) Shorter than normal

(*b*) The two halves do not equal a normal palate

(c) In many cases no muscle movement is seen in the bifid palate or in the superior constrictors.

2. Skull bones There is a definite bony increase in the transverse diameter of the nasopharynx in cleft palate cases. Other asymmetries are not uncommon This applies to cases with cleft in the velum only and is of importance in the consideration of repair

(*a*) There is less than the normal amount of soft tissue. When this is used for closure in the midline, the lateral stretching shortens the anterior-posterior measurement.

(*b*) The widely separated hamular processes are the fixed bony points for the tensor muscles even after the separation of the soft from the hard palate. The palatal aponeurosis remains under tension and is rigid preventing the upper surface of the velum from reaching the pharynx. It is Wardill's belief that failure to relax this tension is one of the chief causes of failure in the operations commonly performed. It often causes the velar immobility which ruins an otherwise apparently good result.

An operation based on these anatomical and physiological facts is described First, the bony nasopharynx is increased in size and mere closure of the velum regardless of its mobility cannot provide the desired valve action Second *the inability to bring a completely functioning palate to the pharynx necessitates bringing the desired part of the pharynx to the palate* This is the purpose of the first stage of the operation completed three or four weeks before the next stage The purpose is narrowing of the pharynx laterally and production of a cushion on the posterior pharynx wall for contact with the superior palate surface. It imitates but exaggerates Passavant s cushion

Wardill reported further on this procedure in 1937 The operation now includes fundamental principles demonstrated by Veau and other contemporaries as well as excellent additions and changes by himself

Veau s appreciation of scar formation and its subsequent contraction opposed the Langenbeck type of flap and insisted upon the closure of all raw surface in the velum He had freed completely the hard palate flaps and resutured them in a position to adhere to the palate bone. He had separated the velar musculature from the mesial surface of the internal pterygoid plate He had freed the nasal mucosa from the palate and sutured its entire length

Wardill expresses appreciation of these principles and makes essential improvements which further accomplish and assure the objective He divides the hamular process to relieve tension and separates all bony attachment of the soft palate. He regards this as *the most impor*

tant procedure. He adds a V Y type of mucoperiosteal flap which prevents any dead space and secures the greatest possible length to the velum.

The operation has the following advantages (1) It is completed in one session (2) the nasopharyngeal valve action is practically assured (3) it is applicable to all types of cleft, (4) the V Y flaps assure maximum length and minimum scar formation (5) if it is performed before the speech age (two years) most children will learn to speak naturally without special training.

The author believes that this is the soundest technic available and consequently describes it in detail. He has drawn freely upon Wardill's thinking and conclusions The illustrations, with slight changes, are his

The recent presentation of an excellent photographic research by Kemper and his colleagues, carried out on two patients whose antrum and nose and nasal septa had been removed surgically giving a clear view of the superior velar surface and the entire nasopharynx, creates several doubts about our accepted beliefs regarding the various muscular actions in the production of normal speech The structure of the palate and velum is normal in both cases. A voluminous film in color was made under the direction of an expert in speech training. These photographs were taken both through the facial-nasal opening, showing all the detail of the velar uvular and nasopharyngeal muscular action in phonation of many test letters words and phrases, and also through the mouth, showing the action of the tongue velum, uvula and pharynx wall during the same phonation.

One of the subjects did not give the slightest visual evidence of any pharyngeal movement during excellent phonation but demonstrated the various actions of the uvula and velum in accomplishing this.

The other patient presented an excellent superior constrictor action —Passavant's cushion—and similar action of the velar structure with excellent phonation.

Much remains to be known about a proper surgical correction. Kemper believes that the palatal aponeurosis, with its essential muscular attachments, should not be sectioned. He makes a diagonal cut in the bone from the cleft margin to the palatine foramen fractures this bit of bone, and carries the incised section posteriorly and medially with the velum.

Other statistical and clinical researches on the effect of surgical disturbance during the developmental period of the bones may also materially change our present type and time of correction. The plan previously discussed impresses the author as being the best available at this time.

Anesthesia. A safe anesthetic for a child having the type of surgery just discussed is given by the intratracheal method, so that any danger of aspiration of blood is precluded. Ayre has proposed an adequate and excellent method. He points out that young infants do not do well with nitrous oxygen anesthesia and rebreathing.

A T tube is used for this anesthesia. A portion of the tube is connected with a continuous flow oxygen-ether vapor apparatus This en ters the horizontal arm of the T at right angles and delivers the vapor into the intratracheal tube The other end of the T is either left open or connected with a piece of rubber tubing which can be carried beneath the sterile drapes.

This tube provides for both the intake and the exhalation of air The baby inhales fresh air and oxygen under as nearly normal physiological conditions as possible. There is no rebreathing bag, expiratory valve or other obstruction to normal respiration. Sufficient ether is added to the oxygen to maintain an adequate anesthesia to keep the child just beyond gagging. Deep anesthesia is neither necessary nor desirable An excellent color and quiet natural breathing are maintained. The con dition of the baby is satisfactory throughout operations continuing half an hour to an hour and a half and postoperative recovery is smooth and free from anxiety

Procedure STAGE 1 PREPARATION FOR THE PHARYNGOPLASTY Make a transverse incision through the mucosa and pharyngeal muscle fibers *to but not through* the buccopharyngeal fascia where Passavant's cushion forms during pharyngeal muscle movement. This cushion is over the anterior arch of the atlas just below the adenoid mass

Put a small sharp hook in the lower margin of the incision and insert a special elevator between the muscle and posterior layer of the fascia Dissect carefully downward and laterally until the instrument passes laterally to each salpingopharyngeal fold. These fibromuscular bands run along the lateral pharynx walls from the eustachian bullae to lie close behind the posterior pillars

Pick up the upper margin of the incision with the sharp hook and separate above to the base of the skull Move the elevator to the lateral ends of the incision pick up the lateral folds, and incise into but not through them A small vertical incision on the inner side of each fold increases the raw surface available for suturing (Fig 37 *a*)

Sutures. The purpose is to narrow the pharynx laterally and produce a ridge or cushion The incision is closed transversely

Pass a half curved, ¾ inch needle carrying 0 chromic catgut through a large part of the fold above the incision on the right and then similarly on the left side. The stitch (suture) is left long and held in an artery forcep until tied later

A similar stitch is passed below the incision and two or three others through the mucomuscular tissue in the central part of the incision to approximate its edges (Fig. 37 *b*)

STAGE 2. PALATAL FLAPS

1 Carry an incision forward from a point lateral to the hamular process along the alveolar margin to the anterior palatine foramen

2. Clear the hamular process with a blunt separator and divide its base with a chisel It may be readily fractured lower but the broken

segment may not carry the untraumatized tendon sheath which is desirable in its ultimate fixed (healed) position. It probably acts more as an elevator than a tensor after this change of position Wardill chooses to fracture.

3 (*a*) Elevate the mucoperiosteum from the palate for the entire length of the incision

(*b*) Push the elevator through the mucosa and incise around the border of the cleft in the hard palate.

The author prefers to incise the mucosa along the line of junction of the oral and nasal mucosa (Fig 37 *e*)

Repeat this procedure on the opposite side.

4 Carry oblique incisions, beginning at the posterior end of the hard palate at the cleft border forward and outward. This incision severs the arteries anteriorly

The flaps outlined permit of closure later like Veau's flaps, to obliterate any dead space (Fig. 37 *f*) between them and the bone.

5 Raise the flap with a sharp hook and separate with an elevator until the posterior free edge of the bone is reached. Insert the elevator behind this edge until the soft palate is free from the bone, leaving the nasal mucosa intact. It may be necessary to accomplish part of this with a knife

Now carefully elevate the nasal mucosa for its entire length.

The principal structure now holding the soft palate to the hard palate is the palatine artery It is true in many cases that the palate cannot be sutured without tension unless the artery is divided. It may be drawn out as far as possible and be either ligated or sectioned and twisted (Fig. 37 *g*)

The whole bony attachment of the soft palate is now exposed to view Continue the dissection near the base of the hamular process the tuberosity and then along the posterior border of the internal pterygoid plate. Do not carry this dissection far enough to risk the attachment of the eustachian tube Blunt dissection readily accomplishes what is desired.

There is now a large space on the outer side into which the lateral incision opens This is bounded mesially by the palate and laterally by the internal pterygoid tendon which may be freely visible.

Wardill states that he has been assured by an anatomist colleague that this space does not communicate with the deep fascial spaces of the neck and consequently does not endanger the mediastinum Any infection would tend to point behind the angle of the jaw (Fig 37 *h*)

6 Freshen the edges of the cleft in the soft palate by excising a strip of mucosa (Fig. 37 *i j*) A little more freedom and thickness of the soft palate tissue is gained sometimes by a scissor snip at the very front and close to the nasal surface of the soft palate.

The author prefers not to excise the mucosa on the cleft border and uvula, but to split it down the median line of the free edge This gives

a wider approximating muscle surface. The approximation of all three layers is accomplished with vertical mattress sutures of 0000 nylon which are passed about ⅜ inch from the free border through the oral mucosa and muscle to and along the nasal mucosa to the free edge then on the opposite side between the nasal mucosa and muscle for a similar distance to emerge on the oral surface. The stitch now passes diagonally down through the mucosal-muscular edge of the second side and from below upward on the first side Tie the stitches loosely with just enough traction to approximate the muscle and slightly evert the edges of the mucosa. We never clean or swab intra-oral stitches and rarely lose one that is *properly tied*

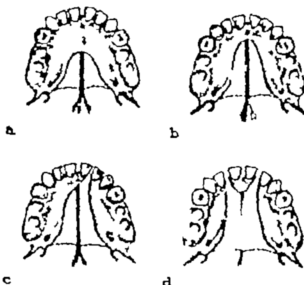


Fig. 36. Types of clefts. *a*, Parietal deficiency of horizontal plate of the palatal bone· *b* major deficiency of the horizontal plate of the palatal bone· *c* cleft including the alveolar process at the junction of the premaxilla, *d* double clefts of the alveolar process along both junctions with the premaxilla.

STAGE 3 COMPLETION OF PHARYNGOPLASTY Now tie the stitches passed in the first stage The various accomplishments of Stage 2 permit easy closure without tension. The closure draws mesially and posteriorly the halves of the free soft palate (Fig. 37 *k*)

STAGE 4 SUTURE OF THE FLAPS Suture the nasal mucosa of the hard palate in the midline with fine catgut after the method of Veau. This proceeds from before backward. Leave several of the anterior sutures long and later pass them through and tie them on the oral flaps to anchor the two together This suturing continues to the tip of the uvula (Fig 37 *k l*) The oral mucosa is sutured with catgut or fine silkworm gut passed as end-on sutures. The author has previously described his practice here

The deep space mesial to the internal pterygoid tendon at the pos-

terior ends of the alveolar incisions is not packed with gauze by the author but with the "absorbable hemostatic gauze Oxycel " made by

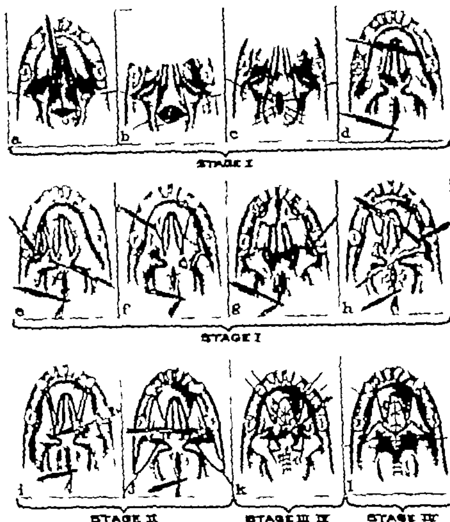


Fig. 37 Cleft palate repair (Wardill method) Stage I Pharyngoplasty *a* Transverse incision, elevation of the mucosa and constrictor fibers vertical incisions to increase the area for suture. *b* Suture passed through the salpingopharyngeal folds. *c* Salpingopharyngeal folds drawn together by suture traction. *d* Incision of palatal flaps. *e* Chisel resection of the base of the hamular process. *f* Oblique incisions of the palatal mucoperiosteum. *g*, Separation of the soft palate from the posterior edge of the palatal bone. *h*, Resection of the posterior palatine artery

Stage II. *i*, Incision of the edges of the soft palate and uvula. *j* Small scissors cut of the inner part of the soft palate, beneath its nasal surface, to increase its freedom and thickness.

Stages III and IV *k*, Pharyngeal sutures tied suture of the mucous membrane of the nasal surface of the hard palate. *l* Soft palate closed with end-on mattress sutures of fine Dermalon.

Parke Davis and Company This is packed tightly It causes no tissue reaction and remains until approximations are healed.

The management of the nasal mucosa described applies to cases where the mucosa of the vomer is not available Much use can be made of this when it is available as is illustrated in Figure 37 *m–q* Use this mucosa in unilateral clefts as shown in Figure 37 *q*

Use the same principles as just described in clefts of the velum only as shown in Figure 37 *r s*

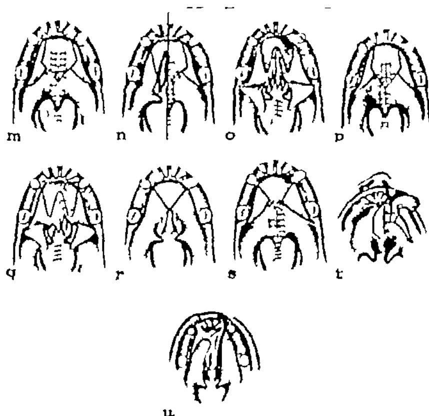


Fig. 37 (continued) *m* Completion of the suture line. *n*, Diagrammatic illustration of a form of V Y advancement of the velum accomplished by these incisions and sutures. *o* Suture of the mucosa from the nasal surface of the hard palate to the incised vomer mucosa. The position of the stay sutures is shown. *p* Completed repair dotted line indicates position of the united nasal mucosa. *q* Use of the vomer mucosa to form the floor of the nose in a single cleft. *r* Velar cleft incisions for the flaps. *s* Repair completed. *t* Repair of a single cleft of the lip and hard palate in one operative procedure (Veau) *u* Repair of a double cleft of the lip and alveolar process in a single procedure (Veau)

Veau and Wardill advise repair of the alveolus in single and double complete clefts at the time of the lip repair as shown in the former's illustrations. This technic greatly facilitates the subsequent repair of the palate (Fig. 37 *t u*) The author prefers to do single lips separately because he follows a technic described later which differs from that commonly used. He wants nothing to interfere with a simple sound procedure which is *routinely satisfactory* in every detail

Repair of Congenital or Acquired Clefts with Tissue from Outside the Mouth

Nassbaum (1880) used a flap based on the root of the nose and cut across the forehead parallel with the eyebrow This was rotated and put through the nose on the side of the base with its raw surface nasally It had no epithelial covering.

Rotter (1889) used a Thiersch graft on a Nussbaum flap and closed a hole in the hard palate after surgery

Eiselberg (1901) reported several operations. Two took tissue from inside the mouth He prepared a flap based at the elbow on the left forearm The edges rolled and adhered in seven weeks. He pared the radial and ulnar surfaces introduced it through the cleft, and sutured it to both cleft borders. The arm was held with a plaster bandage.

Blair (1911) reported the use of a long flap from the side of the neck. This was introduced through the floor of the mouth under the mandible

Rosenthal (1917) used a pedicled flap from the flexor surface of the upper arm

Esser (*1918*) used a flap (nasolabial) from the lateral nose the lip and the cheek including the angular artery This was put into the mouth through the lip and cheek at its base

Pickerill (1928) advised the use of tubed skin from the neck or abdomen stating that he had used it during World War I

The author reported a case in 1942 which had been repaired with an abdominal tube, using the wrist as the carrier (Fig. 38) He has lined the walls of the maxillary antrum and replaced the hard palate in a patient treated by x ray for cancer (Fig. 39)

LOSS OF HARD PALATE AND PREMAXILLARY PART OF ALVEOLAR PROCESS

Total Loss

The condition contemplated here can be repaired with a tubed, ped icled, skin-covered flap taken from the abdomen and transferred on the wrist as a carrier

Procedure. *Stage I* Tube on the abdomen a pedicle of proper length carrying a flap of the required size (Figs. 7 38 *b*) Elevate and delay this pedicled flap at intervals of three weeks until an adequate blood supply has been established

Incise and elevate a semicircular flap on the wrist of the arm of the side opposite to that on which the tubed pedicle is situated. Elevate the flap at the mesial end of the tubed pedicle and suture it to the bor ders of this skin flap on the wrist and of the defect created by its ele vation (Fig. 38 *b*) Support the arm with a dressing which will pre vent any traction on the tubed pedicle Permit the arm to stay in this position until a blood supply adequate for nourishment of the lateral part of this tubed pedicle has been established. It is usually necessary



Fig. 38 Loss of hard palate and premaxillary part of the alveolar process. *a* Total loss of palatal bones and alveolar process at site of the central teeth (premaxilla) nasal oral fistula, *b* one attachment of a tubed pedicled flap transferred from the abdomen to the left wrist *c* skin-covered, tubed pedicled flap, with arm utilized as

to elevate and delay this lateral part once or twice at intervals of three weeks before it can be safely detached from the abdomen Incise the

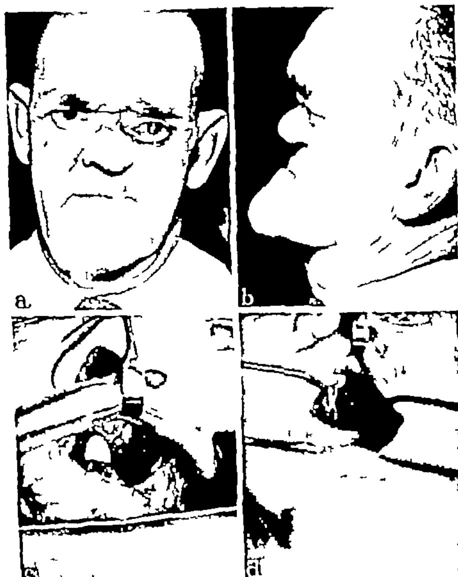


Fig. 39 Palatal, antral and nasal loss. *a*, *b* *c* *d* Appearance eight years later

superior and lateral borders of the flap that remains attached to the abdomen undercut it freely and cover its raw surface with split skin

a carrier sutured into the velar margin of the palatal defect *d*, plaster dressing reinforced with steel straps for fixation of the head and arm in a safe, comfortable position *e* flap united with free margin of velar border of palatal defect, pedicle amputated from the wrist, *f* tubed pedicle opened along its line of union and dissected flat; raw surfaces of border of this flap united with freshened surfaces of bone on the lingual aspect of the alveolar process anterior margin united with freshened borders of the gingival defect.

Dress with a firm gauze dressing and continue to use the dressing for seven to ten days

Incise and elevate the grafted flap at the lateral end of the tubed pedicle *Split the anterior margin of the velum at the posterior border* of the palatal defect. Pare the epithelium from the distal margin of the grafted flap on the tubed pedicle Suture this, with several horsehair stitches into the split edge of the velar border of the defect (Fig. 38



Fig. 39 (continued) *e* Abdominal tubed flap on the arm as a carrier *f g* transfer of the tube to the velum, antrum, *h* finished reconstruction.

c d) Fix the arm and the head with a plaster dressing, as depicted in Figure 38 *d* (see also Fig 8) The strips which connect the head cap to the dressing about the arm and across the back should be reinforced with a thin strip of band iron. The position of the arm and head is not only comfortable but also safe.

An interval of three weeks is allowed to elapse before Stage 2.

Stage 2 Excise the attachment of the pedicle from the wrist. Incise the scar line in the pedicle and dissect it flat Dissect the scar from the lingual surfaces of the alveolar process and excise the margin of the

scar of the alveolar defect in the premaxillary region (Fig. 38, *e*) Suture the anterior margin of the pedicle to the gingival tissue about the premaxillary defect. Pass two or three sutures through the lateral margins of the pedicled flap Tie these around the adjacent teeth Pass two or three interdental wires across the palate to support an iodoform gauze pack which will approximate the raw surfaces of the flap and the freshened alveolar surfaces. This dressing remains in place for five to seven days at which time it is replaced The stitches are removed in ten days. The final repair is pictured in Figure 38 *f*

The patient presented in Figure 39 had a small skin malignancy over the left nasal process treated with x-radiation. The amount was such that the entire hard palate except the right alveolar process, the anterior wall of the left maxilla, left nasal process and bones, and the floor of the orbit sequestered. There is residual corneal opacity and cataracts.

The condition eight years after treatment is presented in Figure 39 *a b* It was necessary to reline the entire antrum, close the hard palate and provide a base and support for a denture (Fig. 39 *c d*) This was accomplished by the use of a tubed abdominal flap transferred on the arm as a carrier (Fig. 39 *e f*) The end of this tube was opened to provide the antral construction and approximation to the velum (Fig. 39 *f g*) The arm tube was severed at the end of eight weeks and approximated to the borders of the anterior defect.

A buccal sulcus to accommodate a denture was grafted after a period of several months. The nasal defect was reconstructed with the desquamated frontal flap and a subsequent dermal inlay The result is presented in Figure 39 *h*.

Repairs Utilizing Tissue from the Mouth and Pharynx and Combined with Tissue from Outside the Mouth

Several procedures were proposed during the past fifty years, some of which are complicated, all of which are destructive of useful functioning tissue and none of which can possibly reproduce function other than separation of the mouth and nasopharynx, or can accomplish more than can be supplied by a skillfully planned denture based upon a closed hard palate The latter can be accomplished certainly without added, visible cosmetic disabilities. The surgeon in most instances, ignores his cosmetic responsibility to gain a functional result, half of which is obviously impossible to obtain.

THE PREMAXILLARY BONES IN DOUBLE AND SINGLE CLEFTS

The premaxilla and prolabium are ordinarily displaced forward and frequently upward. They may also be rotated laterally in double cleft. The upward displacement may be present in any degree. It occasionally results in a horizontal continuation from the tip of the nose with a complete absence of the columella We have again, more than a hundred years of differences of opinion as to proper management and its purposes. These are based largely upon a lack of understanding of the anatomical causes for the malposition and the proper requisite for its correction.

Dupuytren (1839) excised the premaxilla entirely Blandin (1842) cut a triangular piece of bone and soft covering from the vomer and septum The base of this triangle equaled the posterior displacement.

The anterior incision was vertical and the posterior one oblique. It permitted the rotation of the premaxilla downward and backward. It was held in this position by a wire passed around the molars and twisted in front of the incisors in the dentigerous adult or with a plate in the infant. This maneuver tilted the base in, but did not change the septal projection. Bruns (1859) used the philtrum or prolabium to lengthen the cutaneous septum and columella. An occasional surgeon today suggests the removal of the premaxilla, but the majority of operators insist upon its retention. The removal of the premaxilla is a shirking of responsibility because the operator lacks the knowledge of what to do. It is best in moderate displacements to depend upon the lip traction for proper adjustment during the period of development. This frequently occurs within a few months. It may be necessary partially to fracture the premaxilla or partially cut it subperiosteally in order to accomplish this. Bardeleben (1868) sectioned the vomer subperiosteally to permit the two parts to slide past each other. He made an incision 1 cm long on the free edge of the vomer, elevated the periosteum, and made a vertical cut through the vomer.

Any section of the vomer or septum that does not place the premaxilla in its proper position in the alveolar arch permits the cheek and repaired lip muscles to mold the arches behind the premaxilla and becomes a difficult deformity to correct. The patient is usually edentulous and too young for the service of the orthodontist. This is typical of the Wolfe procedure of closing one side of the lip at a time. It produces an acceptable profile and a bad mouth.

Goyder (1913) raised a mucous membrane flap and made a horizontal incision along the level of the nasal floor to permit back sliding of the premaxilla into the desired position.

Brophy (1915) reported section of the vomer submucously, elevation of flaps on the alveolar processes and the premaxilla, freshening of the bone edges, and closure.

Veau and Lascombe (1922) called attention to the necessity of maintaining the desired projection of the premaxilla to support the lip and prevent the flattening of it and the nose. They developed a procedure in which a horizontal section of the neck of the premaxilla permits backward displacement "in a lump as a drawer is closed and [does] not turn it around on an upper horizontal axis like a door that is shut."

There has been a long controversy as to the origin, position and significance of the premaxillary bone. There have been many theoretical disagreements.

THE ORIGIN POSITION AND SIGNIFICANCE OF THE PREMAXILLARY BONE

Veau stated in 1926 that each premaxilla arises from the nasal frontal process alone and that the entire premaxilla lies mesial to the clefts.

Berry and Legg pointed out in 1912 that the premaxilla in single clefts, being unattached to its corresponding maxilla, projects forward

and carries with it its fellow premaxilla. This results in an oblique prominence which pushes the lip forward and tends to widen the cleft. It is frequently desirable to fracture the attached premaxilla to permit the traction of the closed lip to mold it into proper place.

Much can still be added to a sound routine management of a markedly displaced premaxilla.

The excellent contributions of Hellman Broadbent and Brodie on the development of the bones of the face, with particular reference to the nose, palate maxilla and mandible demand the careful consideration of every surgeon dealing with these several congenital deformities. The findings should determine the time and type of procedure

Broadbent superimposed tracings of films made at intervals during the years of development. Measurements are based upon fixed points in the skull which show the smallest or slight variations during this period.

Brodie measured each bone separately instead of the total head during a similar period. He made absolute instead of comparative measurements Face development was studied from the third month throughout eight years. His findings follow

1 The nasal floor remains stable in its angular relationship through the entire period.

2 The occlusal plane and lower border of the mandible do likewise after dental occlusion is established.

3 The jaws are not in approximation at the gum pads before the eruption of the teeth.

4 The constancy of the position of the mandible is maintained by muscle tension.

5 Growth of the alveolar process and eruption of teeth downward in the upper and upward in the lower gradually enclose the tongue and fix the mandible in facial pattern through occlusion

6 The nose is remarkably stable in its proportions. It represents 43 per cent of the total height of the face in the newborn, the child of eight or an adult.

FRACTURES OF THF FACE: BONE LOSS

Injury to the facial bones and particularly to the mandible may be characterized by simple linear fracture external contusion and such fracture or by external destruction with simple or comminuted fracture The last is frequent in accidents of transportation, industry and gunshot wounds

The *frequency* of fractures of the facial bones (Fig. 40) is in the following order mandible nose zygomatic compound (bone and arch) maxilla, and multiple fractures.

Fractures of the Jaws*

The position of fragments in the jaw should be carefully studied. If fixation by wire and elastic bands is inadequate to retain the fragments

* By Brig. Gen. L. C. Fairbank and Col. R. A. Stout, D. C., U S. Army

In correct position impressions of the mouth are taken for the purpose of making and applying more permanent splints (Fig. 41) as soon as the acute inflammatory reaction has subsided.



Fig. 40. Bony anatomy of the face, nose and zygomatic arch. *1* Frontozygomatic articulation *2*, orbital articulation of the zygoma and maxilla, *3* zygomatic process of the maxilla, maxillary zygomatic articulation *4* articulation of the zygoma and zygomatic process of the temporal bone *5* infra-orbital foramen.



Fig. 41 Clear acrylic resin splint stabilizing fracture of the mandible in the region of the mental foramen.

Fractures of the Mandible

The usual injury to the mandible in war is characterized by comminution or external destruction On the other hand, only a contusion of the soft tissues frequently may be evident, but it will be accompanied by

a break in the bone with little or no comminution, simulating the fracture commonly encountered in civil life

Displacement. The degree of displacement in cases of fracture of the facial bones, including the mandible, depends on the direction and strength of the traumatizing force, the amount of comminution the presence or absence of opposing teeth and, above all, the action of the muscles attached to the separated fragments. Fractures in different locations present definite characteristic displacements.

Fractures at Symphysis When there is considerable comminution or loss of substance of the symphysis with loss of teeth the two halves of the mandible tend to be drawn together by contraction of the mylohyoid muscles at the median line so that there is marked narrowing of the lower dental arch (Fig 43)



Fig. 42. Fracture of the mandible in region of the symphysis, with collapse of lateral segments.

Unilateral Fracture of Mandible in Region of Mental Foramen The short fragment posterior to the fracture is elevated and held by contraction of the elevator muscles (temporal masseter and internal pterygoid) with the teeth in normal occlusion with those of the upper jaw when there is a good complement of teeth in both jaws The large fragment is depressed by the muscles running from its lower border to the hyoid bone (digastric, geniohyoid and mylohyoid) so that the anterior teeth do not occlude with those of the upper jaw (Fig. 43)

Moreover there may be some backward displacement and lateral deviation of the chin segment to the side of the fracture with overlapping of the fragments in severe cases of comminution The elevator muscles accentuate the upward displacement of the short fragment when there are no lower teeth opposing the posterior teeth of the upper

jaw (Fig 43 *lower left*) The short, posterior fragment may also be displaced outward or inward.

Bilateral Fracture of Body of Mandible. The chin segment is drawn downward and backward by the hyoid group of muscles, and the posterior fragment is held up by the elevator muscles. This collapse of the middle fragment, especially in cases of comminution may allow the

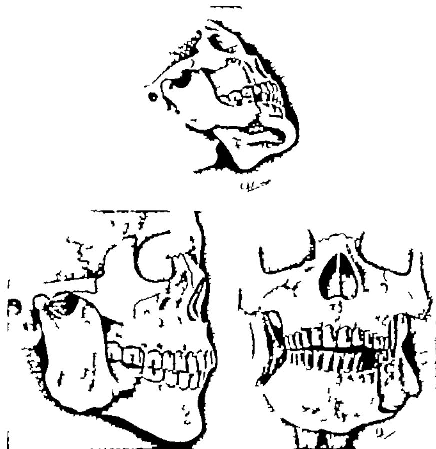


Fig. 43 *Top* Fracture of the mandible with teeth in the posterior fragment, *lower left* unilateral fracture of the mandible without teeth in the posterior fragment; *lower right*, bilateral fracture of the mandible, with typical displacement of the fragments.

tongue and soft tissues to fall back and interfere with respiration and swallowing (Fig. 43 *lower right*)

Fracture of Ramus Displacement may be slight, because of investiture of the fragments by thick muscles, if there is little or no comminution. Shortening will occur with noticeable deviation of the chin toward the fractured side when comminution or loss of substance occurs.

Fracture of Neck of Condyloid Process This fracture is nearly always attributable to indirect force such as a fall or blow on the opposite side of the chin The condyle sometimes is pulled forward and inward, out

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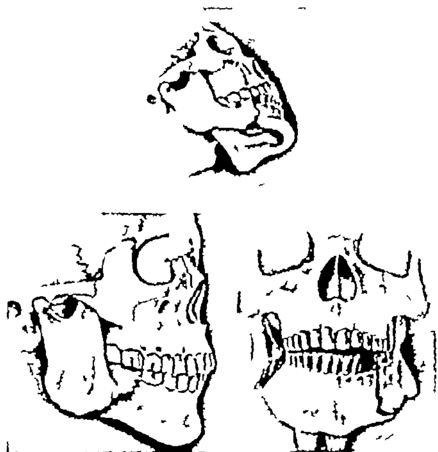


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Fig. 45 *a*, Fracture of the mandible through the angle and third molar tooth, tooth fractured mesial root in anterior fragment, distal root in posterior fragment. *b* Fracture consolidated distal root retained to control posterior fragment until

adequate fixation for a fracture of the body of the mandible with several good teeth on each side of the fracture It has the advantage also of permitting mastication of more or less solid food (Fig 41) Some form of fixation to the upper teeth is necessary for mandibular fracture behind the line of teeth (Fig. 45 *c*) A pin extension from the splint may be needed for control of an edentulous posterior fragment (Fig. 45 *d*) A sectional splint with provision for expansion is indicated for treatment of collapse of the two sides of the mandible attributable to loss of the portions including the symphysis These various types of splints are described in detail on pages 73 to 87

Extra-oral methods of fixation Anderson pins combined with circumferential wiring of the fragments of bone may be necessary when large mandibular fragments are edentulous, thus precluding control by means of the teeth In other cases the circumferential wires can be attached to hooks and bars embedded in a plaster-of-paris head cap (Figs. 75 76 80)

Intramaxillary Wiring and Intermaxillary Elastic Traction and Fixation. Reduction and fixation of the fragments of bone in approximately normal or original position can be accomplished by attaching wire ligatures or arch wires to the teeth if a sufficient number are present in the upper and lower jaws (Figs. 46 47) It may be safe to attach the lower to the upper teeth using traction with *elastic bands* for fixation if the fracture is comparatively simple and there is no embarrassment to the airway and little reaction in the soft tissues. *Do not wire the jaws together immediately under any circumstance* This avoids the danger of complications from vomiting and respiratory difficulty Wiring the teeth to an *arch wire* is a most satisfactory method of maintaining the fragments to avoid collapse of the segments. The nature of the wound may make it impossible to use any other means of intra-oral fixation. Further support of the parts can be secured by the use of bandages. The loss of bone and teeth is so great in some instances that only isolated teeth and bone remain *Multiple loop wiring* for elastic traction will afford suitable fixation at this stage in such cases (Fig. 48)

INTRAMAXILLARY MULTIPLE LOOP WIRING This method of wiring for reduction and fixation of fractures was developed for two reasons to secure the maximal anchorage for traction and retention and to apply the required treatment as rapidly as possible Either Angle's standard brass ligature wire (0 02 inch or 0.508 mm.) or stainless steel wire (0 016 inch or 0 4064 mm.) may be used.

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consolidation took place. *c*, Fracture of mandible; full coverage splint with saddle portion to control posterior fragment, splint wired to upper teeth. *d*, Clear acrylic splint with extension pin to control the posterior fragment is more effective and gives limited function. *e* through *h* Multiple fracture of the mandible. *e*, Dislocation of the condyle upward to a position under the zygomatic arch. *f* Fracture of the neck of the condyloid and coronoid processes. *g* Posterior-anterior view showing additional fracture in the region of the right canine and lateral incisor. *h*, Posterior anterior view: dislocation and fractures reduced, using intramaxillary multiple loop wiring with intermaxillary elastic bands for traction and fixation.



Fig. 45 (continued) *i* and *j* Multiple fracture of the mandible *i* right side condyle in the glenoid fossa, occlusal relation of the teeth restored, *j* left side consolidation taking place occlusal relation of the teeth restored. *k*, Fracture of the neck of the condyloid process. *l*, The fracture reduced and immobilized by placing the teeth in anterior occlusion and cross bite, thereby correcting the posterior border of the ramus. *m* and *n*, Bilateral fracture of the neck of the condyloid process; the condyles displaced anteriorly and medially; occlusion restored by intramaxillary multiple loop wiring, using intermaxillary elastic bands for traction and fixation.

For a stable and satisfactory fixation, we shall consider the application of a single wire with multiple loops to four teeth from the first molar to the canine. This will require a wire about 9 or 10 inches (about 23 or 25 cm.) in length to engage the four teeth form three loops and have the necessary length for twisting the ends together If more teeth are to be included, a longer wire will be necessary (Fig. 48)

Technic and Application. The wire is first threaded through the interproximal space between the first and second molars, from the lingual aspect. The wire is pulled through buccally and forward, along the buccal surface of the teeth as far forward as the lateral incisor allowing sufficient length for the final twisting of the ends at the mesiofacial angle of the canine The long lingual end is threaded through the interproximal space mesial to the first molar passing gingivally to the wire lying along the buccal surface of the teeth. The long end is bent back on itself and is threaded through the same interproximal space forming a loop encircling the short buccal strand At this point the end of the lead wire gauge 8 and about 2 inches (about 5 cm.) long, is inserted in the loop and held parallel with the buccal wire and in contact with the buccal aspect of the teeth (Fig. 48 *a*) The lingual wire is now pulled tightly giving the loop its proper form size and correct relation to the buccal wire and the teeth. The lingual wire is then threaded through the next interproximal space (between the premolars) passing above the buccal wire and the lead wire, the end again is returned through the same interproximal space forming the second loop (encircling the lead wire and buccal strand) In the same manner the next loop is made between the first premolar and the canine and the lingual end drawn tightly so that the lead wire is held rigidly against the buccal surfaces of the teeth. The lingual wire is now threaded through the interproximal space between the canine and lateral incisor and again drawn tightly Pull is exerted forward (mesially) on the buccal wire with the same tension as on the other end. This will draw all the loops up into their proper position and give them the desired uniform size The lead wire is now removed by rotating slightly and moving it forward. This is easily done by grasping the anterior end with pliers or the fingers.

The ends are now grasped with the pliers and twisted a few times so as to stabilize the wire and to bring the twisted portion to rest on the mesiofacial angle of the canine The posterior loop is grasped with smooth-beak pliers (No 122) and twisted three-fourths of a turn, which will place the loop in a horizontal position bringing the buccal wire slightly into the embrasure. The other loops are treated in the same manner This adapts the wire well around each tooth. Starting

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a, Unilateral fracture of the neck of the condyloid process the condyle displaced anteriorly and medially *b* Fracture through the head of the condyloid process, approximately two years before this roentgenogram, the picture discloses establishment of a false joint, with hypertrophy of the bone in the region the joint is capable of good function.

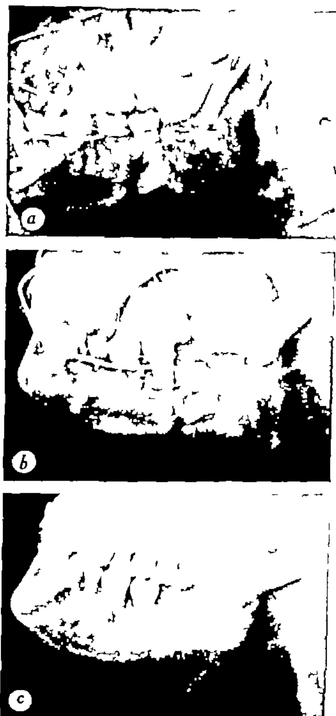


Fig. 46. *a* Gunshot wound, close range with extreme comminution of bone; intramaxillary wiring in place *b* third molar removed, sequestra separated wiring still in place, *c* fracture in region of first and second molars consolidated, sequestra removed bone graft indicated for loss of substance, wiring removed.

are often best treated by use of a splint. When intra-oral extension arms, or arms for rhinoplastic scaffolding are indicated, splints may be used, since they serve as a base to which these appliances can be at tached. A splint provides the maximal anchorage with broad base that can be obtained in one arch.

CONSTRUCTION OF SECTIONAL SPLINTS Sectional splints have some great advantages over the old type of full coverage splints. The occlusal surfaces of the teeth are not covered therefore occlusion is not inter fered with in any way The old type, or full coverage splints depended on cementation to the teeth for retention, and removal was difficult. As cement is not used with the sectional type of splint, application or re moval is a simple procedure. Full coverage splints often caused con siderable gingival irritation but the sectional type of splint has almost entirely eliminated this disagreeable feature.

Materials Vulcanite acrylic resin of the clear type or silver may be used for constructing sectional splints The clear acrylics are probably the material of choice in most cases, since they have certain de sirable properties which the other two materials do not have. *Acrylic* splints are much less conspicuous, and since they are transparent, it is possible to observe the condition of the gingival tissue under the splint at all times. The acrylics have another great advantage in that they are radiolucent. For this reason roentgenograms can be made with the appliance in place, and as the acrylic material casts no shadow there will not be an obliteration of detail by the splint. *Vulcanite* and *silver* are neither transparent nor radiolucent. Vulcanite permits great ease of construction, which is perhaps its only advantage The use of silver is sometimes indicated. It is much stronger than the other materials and for this reason the splint may be made much less bulky without sacrificing strength However the more difficult process of casting and finishing must be regarded as comparative disadvantages.

Impression Compounds. The first requirement in the construction of a successful splint is a good stone model of the remaining teeth and adjacent tissues of both the maxilla and mandible. One of the hydrocolloid impression materials is the material of choice for taking the impressions, from which the models are made. Plaster of paris can be used, but, as accuracy is of paramount importance, modeling com pounds and materials which are subject to distortion are not recommended unless an exacting sectional technic is employed. The splint never should be constructed on the original model, but on one or more duplicated models. In making the splint an accident might occur neces sitating a new start, but this would be comparatively simple provided the original model was intact. The original or master model also will serve as a case record.

Preparing Models. When there is marked displacement of the frag ments, the impression is taken of the parts in their displaced position no attempt at reduction is made at this time The stone model made from this impression is duplicated The duplicate model is cut along the lines of fracture and is reassembled with the teeth in the same oc

efficient, and the comfort and welfare of the patient must always be considered. In the final result the teeth should be in their original occlusion. A large percentage of fractures can be most satisfactorily reduced by wiring, using elastic bands for traction and fixation *the preferred treatment is the simplest one that will give the desired result.*

Certain conditions often encountered require more elaborate treatment than simple wiring and elastic traction. An example of this would

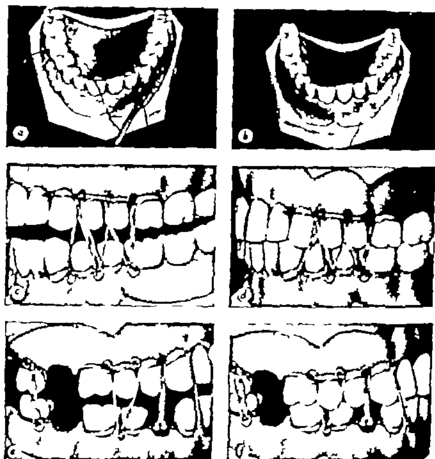


Fig. 48 *a* and *b* Steps in application of multiple loop wiring to models; *c* and *d* multiple loop wiring on models, illustrating application of elastic bands forming a triangle, with base in one arch and apex in the other *e* and *f* application of the loops to single teeth and the method of twisting wire to bridge edentulous portions of the jaws.

be delayed union or nonunion of the fragments, and the treatment would necessarily be extended over a long period. Another example would be a case in which there is extensive loss of bone or collapse of the fragments, and the parts must be held in their proper positions while a graft is inserted and is undergoing consolidation In these cases it would be most desirable to maintain function. This could be accomplished by the use of splints. Also fractures requiring gradual reduction

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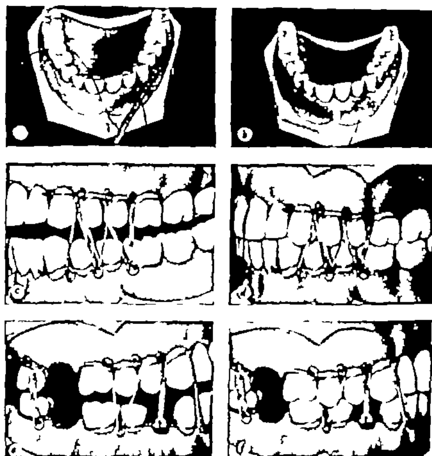


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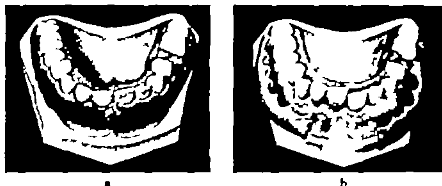
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clusal relation with the opposing teeth as before the fracture was sustained. The reassembled model is then duplicated, and the actual fabrication of the splint is accomplished on this second duplicated model, or working model as it might be called. During the casting or vulcanizing process the working model will be destroyed but the reassembled model from which it was made will still be available for fitting and finishing the splint.

Principle of Sectional Splint. There are numerous variations of the sectional splint, but they are all modifications or elaborations of the simple three-piece basic design. This splint consists essentially of one lingual segment and one buccal segment hinged distally on each side to the last tooth to be included in the splint. The buccal segment is divided into two sections by a vertical split at the median line (Fig. 49) The sectional splint depends for retention and stabilization on its



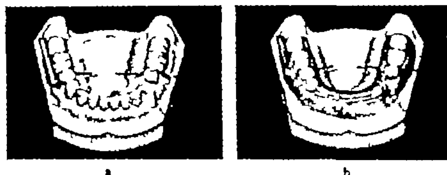
a b

Fig. 49 *a* Sectional splint, closed by applying two turns of a ligature wire around the undercut button *b* ligature wire removed splint released.

grip on the contoured parts of the crowns of the teeth. Ordinarily the middle and gingival thirds of the crowns are covered. It is neither necessary nor desirable to cement this appliance to the teeth. The splint should be extended over the gingival tissues a distance of $^{1}/_{16}$ or $^{1}/_{8}$ inch (2 or 3 mm.) This gingival extension serves as protection to the gingiva and also improves oral hygiene A flat, undercut button about $^{1}/_{4}$ inch (0 6 cm.) in diameter is built into the labial part of the splint at the median line. The vertical cut which divides the buccal segment into two sections passes through this button. When the splint is placed in position in the mouth, a ligature wire is passed around the halves of the button When this wire is tightened, the two buccal sections are pulled firmly about the teeth thus producing the grip by which the appliance is secured.

Adaptation of Hinge Wires. With suitable working models prepared, the first step in the actual construction of the splint is adaptation of the wires which act as hinges or connectors. The material best suited for this purpose is 14 gauge half round, gold clasp wire or nickel-silver wire of the same size and shape Orthodontia band ma

terial can be used, but the half round wire is much more satisfactory The hinge is formed by carrying the wire around the distal surface of the last tooth, to be included in the splint on each side of the mouth The wire should be kept as far gingival as possible without impinging on the soft tissues. It is carried around on both buccal and lingual surfaces of the tooth as far forward as the mesial surface, or even farther forward if additional strength is required. At this point the wire is bent away from the tooth at an angle of approximately 90 degrees and is cut off about ½ inch (1.3 cm) from the surface of the tooth on both buccal and lingual sides (Fig. 50 *a*) These right-angle extensions are the means by which the wire will be held in place while the case is being packed and cured as they will later be embedded in the investment when the case is flasked for packing. Close adaptation of the wire is not desirable except on the distal surface A certain amount of space



a b

Fig. 50. *a*, Hinge connectors with right-angle extensions on model *b* splint pattern waxed to desired outline and contour

between the hinge and the buccal and lingual surfaces of the teeth is necessary since the wire must be well embedded in the splint material to prevent it from breaking attachment.

Making Wax Pattern. The hinge wire and tubing, properly adapted, are fixed on the model with a little sticky wax. A wax pattern of the splint is then built exactly as it is to be when finished except that the buccal segment is solid The cut at the median line which divides the buccal segment into two sections is not made until after the case has been cured and polished For making a vulcanite or an acrylic splint one and a half thicknesses of pink base plate wax will give the proper bulk consistent with adequate strength The wax pattern of the splint is simply a band of wax around the teeth on the model It covers about three-fourths of the buccal and lingual surfaces of the teeth and extends over the gingival margins ⅟₁₆ or ⅛ inch (2 or 3 mm) The right-angle wire extension must, of course extend beyond the surface of the wax so that later they can be embedded in the investment material (Fig. 50 *b*) The wire on the distal surfaces of the teeth should be free from wax since the spring action of the wire is to be maintained It must be understood that the wires are simply connectors be-

tween the lingual segment and the two buccal sections, that they hold the three parts of the splint together in a single unit but that they also permit the buccal sections to be sprung outward, or opened so that the appliance can be placed on the teeth or removed.

Management of Edentulous Portions. Any edentulous spaces that may be present are filled with wax to within $\frac{1}{32}$ or $\frac{1}{16}$ inch (1 or 2 mm.) of the occlusal surfaces of the teeth adjoining the space. After the splint has been cured and polished the material in these edentulous spaces will have to be cut vertically from mesial to distal aspects, in order to permit the splint to be opened. These cuts, as well as the one through the button at the median line, are made with a fine saw. If two holes are drilled through the splint material in one of these



Fig. 51 Countersunk holes in edentulous regions for application of ligature wire.

edentulous spaces, from buccal to lingual aspects, and a ligature wire is passed through them and tightened the grip of the splint on the teeth will be materially increased at these points. The region around the openings of the holes should be countersunk so that the twisted ends of the ligature wires will lie below the surface of the splint and the cheek will not be irritated by its rubbing against the wires (Fig. 51).

Replacing Missing Teeth. Frequently in cases of fracture one or more anterior teeth are missing. It is a simple matter to replace them with vulcanite teeth attached to the splint, and this procedure is often desirable for esthetic reasons (Fig. 49). Teeth of the proper size, mold and shade are selected and ground to fit as would be done for any partial denture and are placed in position on the model before the wax has been applied. After the waxing has been completed, the pins and ridge lap of the teeth will be attached to the lingual segments of the splint. The labial surfaces of the replaced teeth will be under the wax forming the buccal segment, but since this part of the appliance must be free to lift away from the vulcanite teeth a separating medium must

be placed between the porcelain and the wax overlying it. Tinfoil 0 001 inch (0 00254 cm) thick burnished over the labial surfaces of the replaced teeth, serves this purpose very well and permits easy separation of the buccal part of the splint after vulcanization

Steps in Curing. When waxing has been completed, the occlusal portions of the crowns of the teeth on the stone model are cut off flush with the wax. The case is then invested in the lower half of a flask, and 0 001 inch (0 00254 cm) of tinfoil is carefully burnished over the wax and model as for any acrylic denture (Fig. 52) The top half of the flask is placed in position and the investing completed. Elimination of the wax is accomplished by boiling in the usual manner The hinge wires are retained in the upper half of the flask because the right

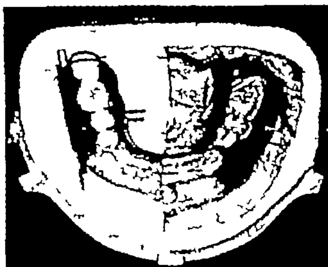
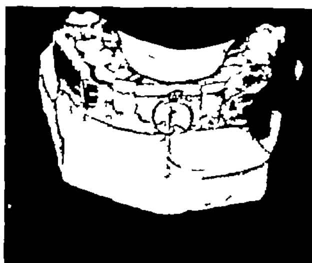


Fig. 52. Splint pattern in lower half of flask, with tinfoil on half of it.

angle extensions which projected beyond the surface of the wax have been embedded in the investment material. The model which is in the lower half of the flask is now covered with tinfoil since the acrylic resins must not be permitted to come in contact with plaster and both sides of the case should be protected by tinfoil unless, of course, an investment becomes available which will eliminate the necessity for this. Packing, closing of the flask, and pressing are the next steps in order and the splint is then cured, either by boiling or by vulcanizing, according to individual preference Curing by boiling is perhaps the simpler process of the two but the stone model and plaster investment are not broken down by a temperature of 212° F and it is sometimes a little difficult to remove the splint. The higher heat used in the vulcanizing process breaks down the plaster and stone, making removal of the case comparatively easy The properties of the cured acrylic seem to be about the same regardless of which method of curing is used.

Completion On removal from the flask the splint is trimmed and polished the buccal segment is divided into two sections by sawing

vertically through the button at the median line and any edentulous parts are cut through mesiodistally The appliance is then fitted to the original model and any necessary minor adjustments are made so that it will go into place perfectly Careless trimming must be avoided, par



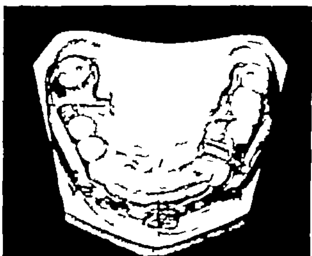


Fig. 53 Clear acrylic splint with parallel square tubes on each side for anchorage of intra-oral or extra-oral extension arms.

ticularly around the parts in contact with the teeth for removal of too much material will impair the grip of the splint and reduce its efficiency

CONSTRUCTION OF ATTACHMENTS The foregoing has described the construction of the simple basic splint without attachments Extension arms either intra-oral or extra-oral are often required to immobilize effectively certain types of fracture If these attachments are to be used sections of square tubing are built into the splint, and the extension

arms are made of square wire which fits snugly into the tubing. After the hinge wires have been adapted, a piece of tubing is cut to the desired length and placed in position on the model. The location will vary somewhat with individual cases, but usually the tubing is placed

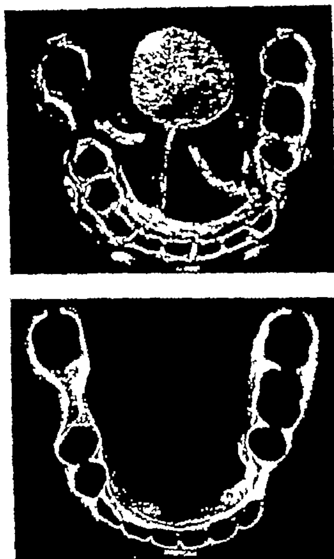


Fig. 54 *Top* Cast-silver splint with buttons and sprues still attached *bottom* same splint polished and ready for cuts to be made through edentulous parts and the median line.

on the buccal surfaces of the molar teeth and lies parallel to the occlusal plane (Fig. 50). Ordinarily the tubing can be soldered to the hinge clasp wire and will be held in place during packing and curing along with it. Occasionally, however, it may be necessary to place the tubing in such position that it cannot be attached to the hinge. If this occurs it is waxed to the model in the desired location and a wire is

inserted long enough for its end to project well beyond the ends of the tubing and to be embedded in the investment when the case is flasked (Fig. 52) By this method the wire is held stationary, since both its ends are buried in investment. The tubing is like a sleeve on the wire and, as it fits accurately there is enough frictional retention to keep it in position The case is then waxed and carried to completion as heretofore described.

Materials. The square tubing and wire used in making the attachments that have been mentioned are of nickel-silver Short intra-oral extension arms usually require 10 to 14 gauge tubing and 10 to 14 gauge wire Extra-oral arms and arms for rhinoplastic scaffolding are necessarily of greater length and must be made from more rigid material. The obvious solution to this is the use of material of larger

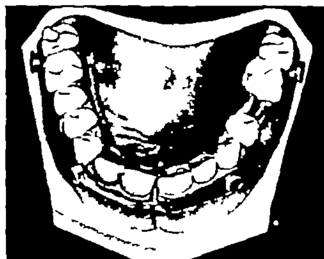


Fig. 55 Cast-silver splint with undercut buttons for intra-oral or extra-oral traction splint replaces two anterior teeth.

gauge, but in some cases the added bulk might be a serious objection. Perhaps a more desirable method is to solder two tubes of small gauge parallel to each other and to insert wires in each of them (Fig. 53)

VULCANITE SECTIONAL SPLINT The construction of a vulcanite splint is identical in every detail to that of an acrylic splint, with the single exception that use of tinfoil is unnecessary if vulcanite is used.

SILVER SECTIONAL SPLINT If the appliance is to be made of silver there are a few differences in the various steps of construction, but in general the process is the same The silver splint is cast directly to the model, so that the working model is made with a good investment material instead of stone The hinge wires and tubing are adapted and held in position in exactly the same manner as in the other types of splints. As the main advantage of the silver appliance is greater rigidity with less bulk, the waxing is lighter two thicknesses of 28 gauge casting wax usually are sufficient. The case is sprued (Fig. 54) Invested

burned out and cast as would be done for any large one-piece casting. The melted silver flows around the hinge wires and embeds them just as the acrylic resins or vulcanite does except that the union is stronger in the case of silver If the metal fails to cast completely around the

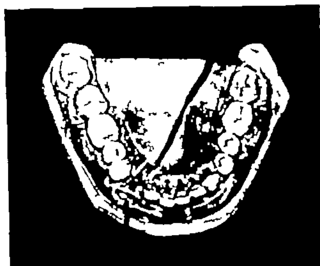


Fig. 56. Clear acrylic splint labial and lingual segments fixed in place by ligature wire through edentulous portion no hingle connectors used.



Fig. 57 Splint, with one hinge connector fixed in position with ligature wire passed through holes in edentulous part.

wire or if the union is not quite perfect the defect can easily be remedied by application of a little gold or silver solder Pure silver is not desirable for making splints, since it is too soft and is not rigid enough Ten per cent of copper added to the pure silver will overcome these objections and make a suitable alloy for splints

PROVIDING FOR TRACTION In some cases in which a sectional splint

is applied it may be desirable to establish intermaxillary elastic traction as well If this is true small flat, undercut buttons should be built into the splint at the time the waxing is done Elastic bands can then be hooked around these buttons the opposite ends being carried around

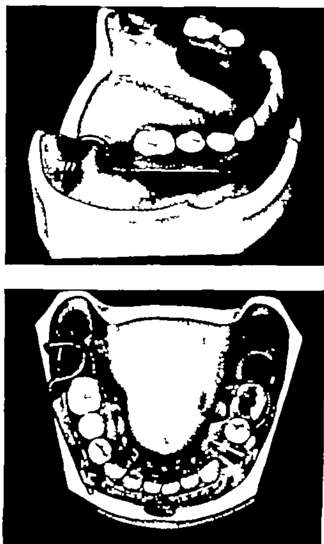


Fig. 58 Sectional splint with intra-oral extension arm for control of posterior fragment in case of fracture of body of mandible, without teeth in the posterior fragment.

the loops of intramaxillary multiple loop wiring placed on the teeth of the opposite jaw These buttons can also serve as attachments for extra-oral traction. The buttons should be placed on the buccal surface of the splint, preferably one in each cuspid region and one in each third molar region (Fig 55) They are placed at these particular points because from them the elastic bands can be applied so as to produce traction in any desired direction

MODIFICATIONS OF SECTIONAL SPLINT Some variations of the sectional splint are even more simple than the basic three-piece design which has been described and some of course are much more complicated. The steps of construction however are essentially the same



Fig. 59 Another view of appliance described in Figure 58



Fig. 60 Cast silver splint labial section divided at the edentulous part, eliminating labial undercut button.

for any of them The photographs accompanying the following short descriptions will illustrate a few of the more practical modifications

Figure 56 shows the sectional splint in its simplest form. It consists of a buccal segment and a lingual segment with no wire hinges or connectors. The lower right canine tooth which was in the line of fracture has been removed. The splint material in the region of the canine has

been cut through mesiodistally, dividing the appliance into two pieces Two parallel holes, drilled through the edentulous part, permit a ligature wire to be passed which when tightened, pulls the two segments

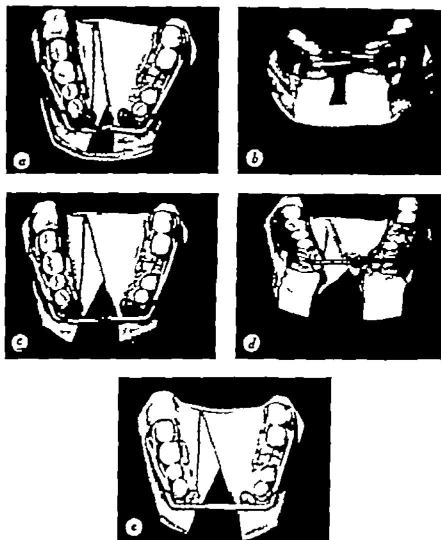


Fig. 61 *a* and *b* Sectional splints anchoring overlapping extension arms for the application of elastic traction, to expand the arch in a case of collapse of lateral segments, *c* and *d*, same case, expansion obtained, *e* square tubing over ends of square wire extension arms acts as a simple retainer

together thereby producing the necessary grip on the teeth. This splint is limited in its application. It is most useful in treatment of simple fractures or in cases of delayed union wherein retention and stabilization are desired during the final stages of consolidation.

Another simple splint is illustrated in Figure 57 consisting of one buccal and one lingual segment hinged on one side only Parallel holes

are drilled through each of the edentulous parts in the first premolar regions. Ligature wires passed through these holes, and tightened, secure the appliance to the teeth and hold it in position

One of the most useful variations of the basic design is that shown in Figures 58 and 59 An intra-oral extension arm has been added for the purpose of controlling an edentulous posterior fragment which tends to an upward and outward displacement because of the muscles attached to it. Ligature wire around the undercut button at the median line normally will hold the splint in place but additional retention can

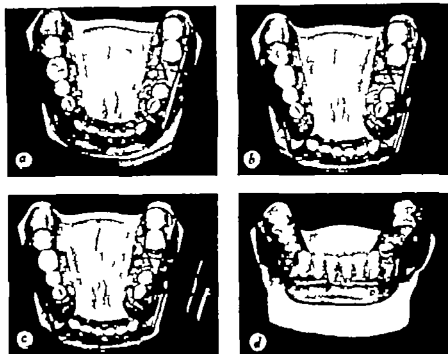


Fig. 62. Another removable retention appliance which also is a stent and replaces *the anterior teeth for esthetic reasons.*

be obtained by wires passed through holes in the edentulous parts as shown in the illustrations.

In the splint represented in Figure 60 the median line button has been eliminated. The usual mesiodistal cut is made through the left canine and premolar region. A second cut is made at right angles to the first one but through the buccal segment only This divides the buccal segment into two sections and allows the splint to be opened. Ligatures passed around the ends of the buccal sections and the lingual segment pull the parts into position and produce the necessary grip

One of the most interesting modifications is the appliance represented in Figure 61 *a b c d* In this case collapse of the fragments has taken place and a splint which will produce expansion is necessary In reality there are two separate unilateral sectional splints, each

having a tube into which intra-oral extension arms are inserted. Elastic bands placed around hooks on the ends of the arms produce the necessary traction for expansion and reestablishment of the former occlusal relation of the teeth.

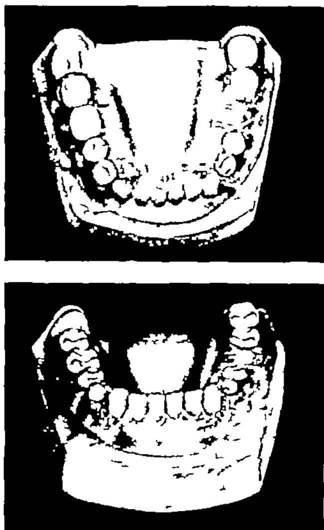


Fig. 63 Acrylic splint with lingual section divided at the canine region so that the lingual parts can be moved medially to permit application of the splint.

Figure 61 *e* represents the same case A section of square tubing slips over the ends of the extension arms as a sleeve thus maintaining the right and left fragments in the expanded position

A more complicated splint, which serves the same purpose as that represented in Figure 61 *e* is the one illustrated in Figure 62. The anterior segment, which maintains the expansion consists of square wire to which porcelain teeth are attached by an acrylic base The ends of the wire slip into the tubes on both unilateral splints and the sec

tion is held in position whereby it not only maintains the expansion but restores lost teeth and tissue as well. This appliance has the added advantage of being removable in case restorative surgical procedures are indicated in the region of the symphysis.

An acrylic splint for the same type of case but made in a single piece without the use of tubes or arms is pictured in Figure 63. The cuts are made on the lingual section just mesial to the first premolar teeth. The portion from canine to canine is solid and is continuous with the buccal segment, the porcelain teeth being attached to this part. When open the two lingual sections swing inward, and when closed they are secured to the buccal segment by ligature wires which pass through holes in the splint, mesial to the first premolars.

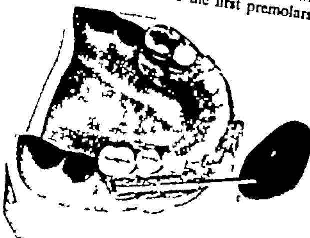


Fig. 64 Splint with intra-oral extension arm and stent used in connection with certain dermal grafts.

Figure 64 represents a stent of modeling compound supported by an intra-oral extension arm attached to the simple three piece, basic sectional splint. The use of a stent is of value in connection with certain intra-oral operations, such as the making of dermal grafts deepening of the buccal sulcus, or lowering of muscular attachments.

External Pin Fixation for Edentulous Fragments of Mandible. The control of edentulous fragments or satisfactory fixation for fractures of edentulous jaws has always constituted a serious problem. In many instances the methods presented have proved most gratifying. In the care of some patients of the type here considered, however it will be found necessary to resort to a more stable extra-oral method of direct skeletal reduction and fixation of fragments.

The method introduced by Roger Anderson for fractures of long bones has been adapted for use in some cases of fracture of the edentulous mandible. Made of stainless steel the appliance can be assembled and sterilized ready for attachment.



Fig. 65 *a*, Fracture of the mandible through the angle and third molar tooth tooth fractured mesial root in anterior fragment; distal root in posterior fragment. *b* The fracture consolidated distal root retained to control the posterior fragment

The simple apparatus consists of two or more locking units each of which firmly holds two Kirschner pins, for engagement of the fragments an adjustable traction bar is attached to the locking units. The pins are 1.5 mm. in diameter and 2 or 2½ inches (5 or 6 cm) in length. One end of each pin is threaded and sharpened as a drill point, and the other end is prepared to engage a T-bar wrench Bars of various lengths and some with angle extensions are supplied for use in cases in which there are multiple fractures and for those in which a fixation point in the ramus and the symphysis is required. Simplicity ease of applica tion wide variation of movement for adjustment, accuracy, and means for immediate reduction and rigid fixation of fragments in final posi tion are the characteristics of the pin appliance (Fig. 67)

Use of the apparatus, however demands the most careful applica tion and skill on the part of the surgeon Scrupulous attention to surgical care of the skin and soft tissues is necessary before fixation of the pins. After the operative field has been surgically prepared a bistoury is used to cut the skin over the points where the pins are to engage the bone fragments. Moreover complications extensive necrosis, and osteomyelitis will result unless careful attention is given to the details of application.

Experiences here and abroad indicate that use of the bone bur in preparation of holes for insertion of the pins is contraindicated, for the heat generated by the rapidly moving bur will burn bone and kill bone cells. This will result in necrosis or destructive and complicating osteomyelitis. Insertion of the pins is accomplished by screwing them into the fragments close to the inferior border of the fragment of the mandible. Slowly the drill-pointed pin will thread itself into the fragment in such a manner that it can be firmly held by the locking unit. The pins may engage the fragment at divergent or convergent angles, but must be so placed that they can be securely engaged by the locking unit.

When properly applied the apparatus will immobilize the fragments permit function of the mandible and assure repair of the bone with a minimum of discomfort to the patient. The pin appliance should not be used if patients have firm and healthy teeth in each fragment, for other methods of fixation presented in this text are then superior

Circumferential Wiring of Mandible When teeth are insufficient for attachment of wires to control a displaced fragment, circumferential

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until consolidation took place. *c* Fracture of the mandible, full coverage splint with saddle portion to control the posterior fragment splint wired to upper teeth. *d* Clear acrylic splint with extension pin to control the posterior fragment is more effective and gives limited function. *e* through *h*. Multiple fracture of the mandible. *e* Dislocation of the condyle upward to a position under the zygomatic arch. *f* Fracture of the neck of the condyloid and coronoid processes. *g* Posterior-anterior view showing additional fracture in the region of the right canine and lateral incisor *h* Posterior-anterior view dislocation and fractures reduced, using intramaxillary multiple loop wiring with intermaxillary elastic bands for traction and fixation.



Fig. 65 (continued) *i* and *j* Multiple fracture of the mandible *i* right side condyle in the glenoid fossa, occlusal relation of the teeth restored *j* left side, consolidation taking place occlusal relation of the teeth restored. *k* Fracture of the neck of the condyloid process. *l* The fracture reduced and immobilized by placing the teeth in anterior occlusion and cross bite, thereby correcting the posterior border of the ramus. *m and n Bilateral fracture of the neck of the condyloid process the* condyles displaced anteriorly and medially occlusion restored by intramaxillary multiple loop wiring, using intermaxillary elastic bands for traction and fixation.

wiring of bone may be used to immobilize the parts until satisfactory consolidation takes place

TECHNIC AND APPLICATION A small incision is made through the skin at the lower border of the fragment which the wire is to embrace and the full-curved pedicle needle is passed through this incision close to the lingual side of the bone, until the mucous membrane of the mouth is pierced. A piece of 24 gauge brass or stainless steel wire is threaded through the eye of the needle in the mouth and one end drawn by means of the needle, out through the incision in the skin (Fig. 68 *above* and *lower left*)

If after embracing the bone the two ends of the wire are to come into the mouth the needle is next passed down from the vestibule of the mouth on the outer side of the bone through the incision in the skin then the end of the wire which protrudes through this incision is carried up into the mouth on the outer side of the bone by means of the needle The wire then embraces the fragment of bone with its two ends emerging in the mouth (Fig 68 *lower right*) These ends then can be secured in the manner applicable in the particular case such as to the upper teeth or twisted together over a splint resting on the alveolar mucosa of the lower jaw (abbreviated outline of periphery of a denture)

If the ends of the wire are to emerge from the incision in the skin the needle is passed, after the first step up into the mouth on the outer side of the bone through the cutaneous incision and the end of the wire that is in the mouth is then drawn down on the outer side of the bone to emerge externally

Traction can be made and maintained on the fragment in the direction indicated by attaching elastic bands to the ends of the wires. These can be anchored to a head cap or some other point of anchorage (Fig. 75)

FORWARD TRACTION OF MAXILLA Fractures of the superior maxilla frequently cause displacement of the loose structures downward and backward so as definitely to interfere with respiration The anterior part of the jaw may drop backward and cause serious interference with respiration in cases of bilateral comminuted fracture of the posterior part of the mandible.

TONGUE-DEPRESSOR METHOD The front of the jaw can be held forward, in a case of this kind, by a simple emergency splint for extraoral traction Four wooden tongue depressors adhesive plaster a bandage 2 inches (5 cm.) wide and the ligature wire supplied with the maxillofacial kit are used. Two of the tongue blades are placed end to end, and the two other tongue blades, overlapping the first two in

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o Unilateral fracture of the neck of the condyloid process, the condyle displaced anteriorly and medially *p* Fracture through the head of the condyloid process, approximately two years before this roentgenogram the picture discloses establishment of a false joint, with hypertrophy of bone in the region the joint is capable of good function.

the middle are wrapped with adhesive tape. This more or less flexible piece is placed vertically with the lower end at the level of the chin, and is fixed to the forehead with a bandage. The upper end is held back with a broad piece of adhesive tape passing over the top of the head to the bandage at the occipital protuberance. A wire passed

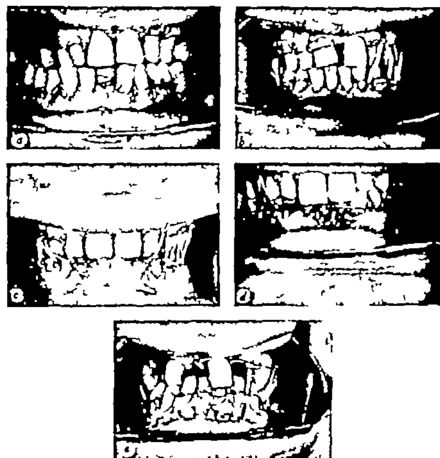


Fig. 66. a, Intramaxillary multiple loop wiring applied before application of elastic bands, *b c d, e* variations in the application of intramaxillary multiple loop wiring, using elastic bands for intermaxillary traction and fixation, as indicated.

around the teeth or fragment of bone and attached to the splint with elastic bands can be used to control depressed fractures or segments of the superior maxilla. A wire passed around the lower front teeth, or around the chin segment of the mandible and attached to the lower end of the tongue-blade splint with a suitable elastic band will provide sufficient traction effectively to maintain the anterior segment of the mandible (Fig. 69)

COAT-HANGER METHOD A more stable emergency apparatus for forward traction of the maxilla or mandible is made from two ordinary

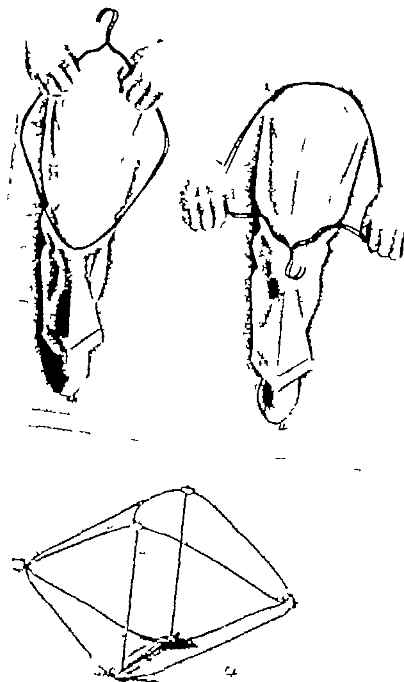


Fig. 70 *Upper left* and *right* Method of bending two coat hangers to form the upper and lower halves of the wire frame. *Lower* The upper and lower half stabilized by wire secured with adhesive tape.

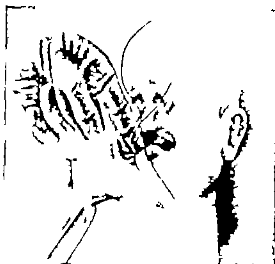




Fig. 68 Circumferential wiring, using a pedicle needle to carry the wire around the bone. The steps are explained in the text.



a



b



c

Fig. 69 Extra-oral traction appliance using circular bandage, tongue blades, and adhesive tape for stability *a* Profile *b* rear view *c* front view

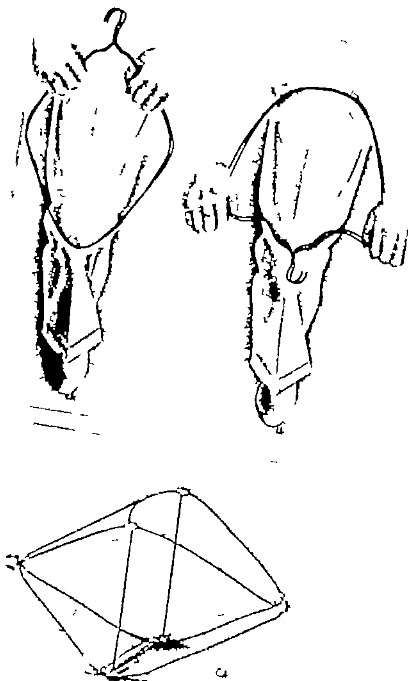


Fig. 70 *Upper left* and *right* Method of bending two coat hangers to form the upper and lower halves of the wire frame *Lower* The upper and lower half stabilized by wire, secured with adhesive tape.

will have been applied previously The hooked part of the coat hangers extends well in front of the face the hooks being cut off. Forward traction on either upper or lower jaw is then made by means of a heavy elastic band extending from multiple loop wiring on the teeth to the anterior point of the coat hangers (Fig. 71 *b*) For feeding and so on the apparatus can be released and turned back over the head by disconnecting the bandage which runs across the neck and between the two lower angles (Fig. 71 *c* and *d*)

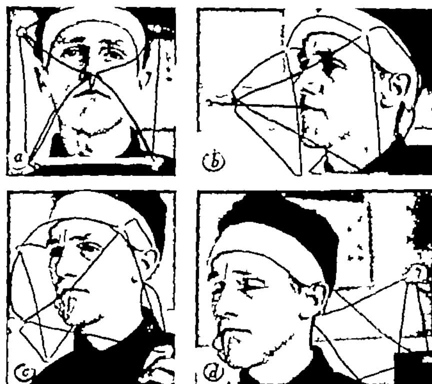


Fig. 71 *a* and *b* Wire frame in position, using a circular bandage with occipital anchorage for anterior elastic traction *c* elastic bands and connecting bandage unhooked for removal of frame *d* frame turned over the head to rest behind it.

Management of Soft Tissues Attention is given to the wound in the soft tissue after satisfactory reduction and fixation of the fracture The surgeon may be tempted to close large, gaping wounds of the soft tissues by suture before giving attention to the fracture. This should not be done until at least temporary fixation of the bony fragments has been accomplished. Collapse of the lateral segments or marked overlapping of fragments can be avoided in addition, deformity and interference with function are not likely to occur

Débridement as understood concerning wounds of other parts of the body is not carried out so extensively in relation to wounds of the face since vascularity of the face favors resistance to infection to a

greater extent Shreds of obviously devitalized tissue are cut away but displaced flaps of tissue may be sutured back in approximate position Great *care* should be taken *to avoid injuring branches of the seventh nerve and salivary duct* Edges of skin and mucous membrane in large wounds communicating with the mouth should be sutured together so as not to leave raw surfaces and bone exposed. Such exposure invites infection and formation of much scar tissue Wounds of the soft tissue communicating with the mouth or involving the mandible that become infected should have dependent drainage provided Wounds associated with the superior maxilla with adequate soft tissue remaining may be completely closed and if drainage is indicated an intra-oral point may be established. The great value of the sulfonamides penicillin, streptomycin and other antibiotics is generally recognized in the treatment of wounds The local application of or treatment systemically using these medicaments and other similar derivatives that may prove to be efficacious, offers an opportunity to carry many cases to completion without the usual complications

INFLAMMATORY CONDITIONS OF SOFT TISSUES Practically always infection is present from dirt and other foreign material carried into the wound from the outside and because of the easy access of pyogenic bacteria to the badly lacerated and devitalized soft tissues. Exposure of the fracture to the oral fluids which are infected with bacteria, is an other source of infection of bone and soft tissue. Diseased teeth in the region of the injury may be causative factors. Fragments of teeth and bone may be carried into the soft tissues and may set up infection. Lack of early fixation of bone predisposes to infection of the wound. This is manifested by swelling and edema about the edges of the wound, together with a rise in temperature of the body and other general symptoms. Fluctuation may be detected in the swelling. The abscess may be localized, or spreading cellulitis may be present. Gas bacillus infection (*Clostridum welchii*) is extremely rare in wounds about the face and jaws.

FOREIGN BODIES AND DETACHED FRAGMENTS OF HARD TISSUE These may be carried into the bone and soft tissues Among them are parts of the missile itself pieces of clothing, stones glass gravel and other materials. Foreign bodies often complicate the injury by prolonging infection, leading to secondary hemorrhage and also obstructing function of movable parts In a bullet wound the absence of a wound of exit is usually good evidence that the bullet is still present in the tissues It is possible to have a single wound about the jaws without a bullet remaining since it may have entered or made its exit through the open mouth. These foreign bodies may be discovered by clinical examination, but may be revealed only roentgenologically

Any overlooked completely detached fragments of bone any pieces of teeth injured teeth or foreign bodies, revealed by clinical or roentgenologic examination, should be removed as soon as possible

Injuries to Teeth Crowns of teeth may be entirely or partially carried

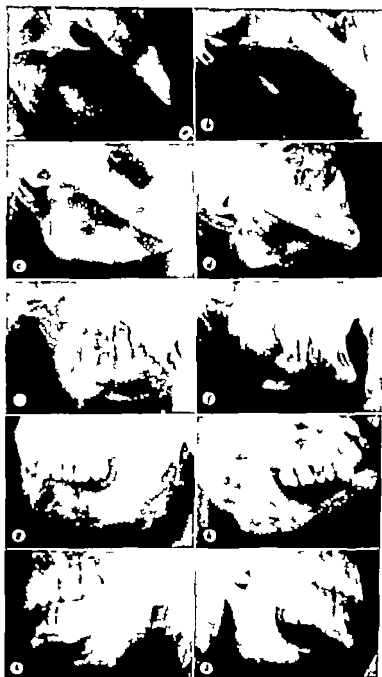


Fig. 72. *a* through *d* Roentgenographic evidence of osteomyelitis of mandible *b* sequestrum formed *c* sequestrum removed *d* consolidation of bone. *e* Osteomyelitis of mandible with pathologic fracture and sequestrum separated, *f* sequestrum and two teeth removed consolidation progressing. *g* and *h* Osteomyelitis, diffuse type, right and left sides of the mandible *i* and *j* consolidation after conservative treatment, with adequate drainage.

away Fragments of teeth may be embedded in the soft tissues set ting up secondary foci of infection and may be discovered by clinical and roentgenologic examination (Fig. 46) Teeth may still be attached to the jaw but may be partially exposed in the line of fracture thus giving rise to later complications, such as cellulitis, abscess osteomyelitis delayed union and so on.

Infection of Bone The factors that contribute to infection of soft tissue cause infection of injured bone. Comminution of the bone espe cially with shattering of teeth and denudation of overlying soft tissues, almost always results in a certain degree of osteitis and later osteomyelitis. This is favored by the presence of devitalized roots of teeth Severe pain in the bone itself is indicative of osteitis The tissue about the fracture is red, tender and swollen and pus may be discharged spontaneously around the teeth The temperature is usually elevated Prolonged drainage through the oral wound, the external wound or an opening in the skin usually indicates that there is a definite osteomyelitic focus in the fragments of bone Spreading of the osteomyelitis is characterized by suppuration around and progressive loosening of previously healthy teeth not immediately in the line of fracture In the early stages of osteomyelitis roentgenologic examination may reveal little. Later blurring of the shadow of the fine, cancellated structure of the bone will be seen (Fig. 72 *a*) Devitalization of a segment of bone results as the infection progresses in formation of a sequestrum A line of demarcation forms between the sequestrum and the adjacent or surrounding live bone and separation of the sequestrum eventually takes place As sequestration occurs a shell of new bone may be formed at the same time to take its place These late changes may be followed more or less closely by roentgenologic examination (Fig 72) Regeneration of the bone after necrosis in the lower jaw is much more common than in the upper jaw

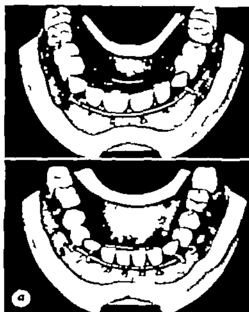
TREATMENT Conservatism should be the rule Nothing radical should be done to the bone in the earlier stages of osteomyelitis Curettage or excision of part of the bone at this time may aid spread of the infection and interfere with regeneration it may do more harm than good. *Provision of drainage* by incisions to the periosteum is all the operative interference indicated in the earlier stages

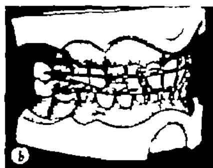
Later as sequestra form and loosen, they should be removed. Sometimes a sequestrum will be locked in a surrounding shell of new bone in which case it is permissible to take away enough of the newly formed shell to free and permit the removal of the sequestrum.

Maxillofacial Orthopedics

Coordination of Specialties. The complex problems confronting surgeons in treatment of injuries of the face and jaws present a great variety of conditions, each type requiring a special method of treat ment. In order to assure the most favorable end results, the plastic and oral surgeon must have available specialists who are able to add their

particular skill. For instance unreduced maxillary fractures, presenting union in malposition, loose fibrous union, or loss of small parts of osseous structures, call for the assistance of the dental orthopedist. It has been soundly established that in many of these cases surgical intervention is not required for correction of the deformities, for it is fre





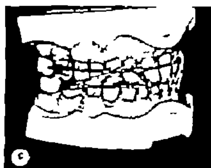


Fig. 73 *a*, Orthodontic appliances, using bands for anchorage on upper and lower teeth, *b* and *c* Intermaxillary elastic bands used in connection with orthodontic appliances for intermaxillary traction and fixation.

quently possible to restore original occlusion or arch form by means of mechanical orthopedic measures. In fact, use of mechanical principles of fixation traction and retention is a dominant force in restoration of the bony structures in all cases of maxillary fracture. More particularly in treatment for old fractures, with segments in malposition, these same forces are used in the gradual reduction of the displaced segments in order to restore original occlusion arch form and relations. The nec essary bony changes will take place under the influence of traction.

The inherent character of bone provides the essentials for change and these can be stimulated by properly directed forces. The orthodontist has developed various types of delicate appliances for correction of mal occlusion. In the field of maxillofacial orthopedics similar appliances embodying the same principles are used to correct deformities in con nection with fractures of the jaw

Anchorage. Anchorage must be secured over a broad area. While bands cemented to teeth in each segment may afford anchorage in some cases, several teeth should be included. To immobilize segments of jaw there must be compound fixation, and this anchorage must be distrib- uted to assure stability and to secure the control or movement desired for restoration of arch form and original occlusion. Splints and splint appliances may be described as having the constant factor of compound reciprocal anchorage (Fig. 73)

Bands. Bands adjusted to selected anchor teeth supply attachment for arch wires of various design. Attachment should be secured on all available teeth in each segment (Fig. 73 *a*)

The sectional splint appliance affords the most favorable type of anchorage for a majority of cases. It offers exceptional anchorage and does not require cementation to the teeth. This is particularly impor tant, for the appliance can be removed without danger and without irritation or disturbance of the newly repaired bone.

Traction Appliances: *Extra-oral Traction* It is frequently necessary to secure extra-oral traction for restoration of the original relationship of maxillary structures. This may require occipital or frontal anchorage It can be secured in several ways. Such anchorage is always necessary in treatment of depressed fractures of the maxilla With suitable anchor age properly distributed traction to correct displacement is applied by means of rubber bands.

Frequently the adjustment requires the application of traction with intermaxillary fixation This is true for all those cases in which only the adjustment of the arch relation is required in order to secure restora tion of original occlusion of the teeth (Fig. 73 *b c*)

Where osseous structure has been lost and collapse of the segments has taken place with bony union monomaxillary or intramaxillary trac- tion will be necessary for correction of the deformity The sectional splint affords great possibilities for use of the traction required to restore the fragments to their original position, reestablishing occlusion and arch form (Fig 74 *a b c*)

The traction must be maintained within physiologic limits of the bony tissue It must not be so strong as to become irritating It must be only sufficient to stimulate bone-cell change. The cell-stimulating force (traction) brings about readjustment of the fragments or jaw segments by gradual reduction, with restoration of original relations and bony union.

Fibrous Union. The process of bone repair is complex There are some interesting aspects to bony chan[illegible] der the influence of mechanical

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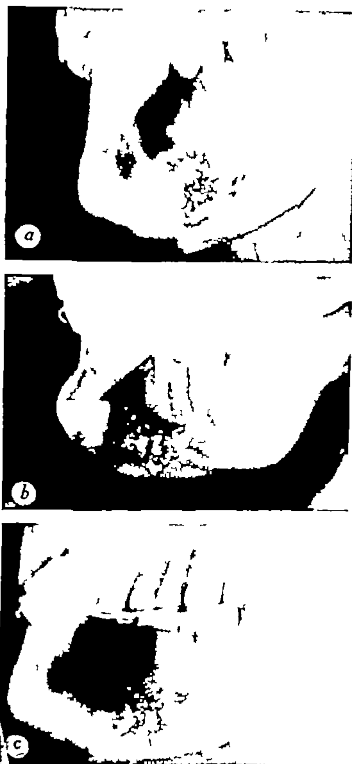


Fig. 74 *a* Injury from richocheting bullet, involving the mandible from the right central incisor to first molar: marked comminution of bone and scattering of tooth

orthopedic manipulation Gradual reduction under the influence of traction is accomplished as a result of transformation of the tissue itself Bone is a derivative of connective tissue and the characteristics of its connective-tissue origin dominate all the problems of its growth regeneration and repair Loose fibrous union in old fractures of the jaw can be treated by traction appliances thus changing the character of the repaired tissue reestablishing normal relations and stimulating the normal tissue transformation with resultant bony repair (cleft palate molded during infancy alveolar cleft or anterior displacement of premaxilla in double clefts molded into position by closure of the lip) An orthodontic example is lateral expansion.

Loss of Bone. In mandibular wounds with loss of small amounts of bone and with collapse of segments or fragments restoration of arch form and original occlusion can be accomplished by slow reduction Sectional splints provide facilities for special intramaxillary traction

Construction of Plaster of Paris Head Cap *Materials Necessary for Construction*

1 Stockinet 3 inches by 2 feet, or about 8 by 60 cm. Three inch stockinet is 6 inches (15 cm) in circumference and capable of considerable stretching. If not available any substitute can be used such as a leg from a pair of balbriggan drawers or a heavy white stocking.
2 Narrow gauze bandage or tape 1 foot (30 cm.) long.
3 Adhesive plaster 1 inch (2.5 cm.) wide
4 Orthopedic felt four (or more) strips measuring 1½ by 6 inches (3 8 by 15 cm) If not available use strips of heavy cotton batting or several layers of an old felt hat.
5 Two plaster of paris bandages 2½ inches by 10 feet (6 cm by 3 meters)
6 Plaster of paris good quality model plaster large plaster bowl and heavy spatula.
7 Traction appliances leather straps and buckles hooks, loops webbing, and so forth as indicated Hooks can conveniently be made from an ordinary wire coat hanger
8 Scissors bandage scissors for felt, small scissors for other materials

Outline of Areas of Head to Be Utilized The direction of stress must necessarily determine the area of anchorage In general the finished margins of the case should extend

1 In the occipital region well over the external occipital protuberance toward the base of the skull

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fragments also marked collapse of lateral segments attributed to delay in treatment and loss of substance *b* and *c* Elastic traction from hooks or loops on overlapping extension arms, anchored to orthodontic bands on the right side and cast-silver sectional splint on the left, used to expand the arch to its normal contour Intermaxillary elastic bands to multiple loop wiring were used to assist in restoring the teeth to their former occlusal relation. Irregular radiopaque areas are thin pieces of lead in the soft tissues.



Fig. 75 *a* through *e* Steps in construction of plaster head cap *f* and *g* wire passed through angle of mandible attached to extension arm from plaster head cap.

2 In the mastoid region as close as possible to the ears but not encroaching on them
3 In the temporal region to about the zygomatic arch definitely below the parietal eminences
4 In the frontal region care must be exercised in freeing the forehead to about 1 inch (2.5 cm.) above the line of the eyebrows

Steps in Construction

1 Seat the patient in a straight-backed chair without a head rest.
2 Clip the hair of men if lengthy fixation (two or more months) will be required otherwise clipping is not considered necessary Have women braid the hair and arrange it in a loose coil on top of the head
3 Apply one end of the stockinet over the head to a point 2 inches (5 cm) below a previously determined border outline of the finished head cap (Fig. 75 *a*)
4 Tie a narrow bandage or tape loosely around the stockinet at the top of the head so that the loop will be about 2 inches (5 cm) in diameter
5 Cut a slit in the stockinet and push the tied ends of the tape through to the inside so that the stockinet can be tightened during later steps if necessary
6. Cut and adjust the felt strips one or more vertically in each quadrant, and fasten them in place on the stockinet with adhesive plaster
7 Pull the free end of the stockinet down over the head and trim it just short of the length of the first layer The felt strips are now between the layers of stockinet There is a small opening at the top of the head in which the ends of the tape are found (Fig. 75 *b c*)
8 Apply the first plaster bandage as follows Wet a bandage in lukewarm water and apply as a head bandage over the stockinet keep the bandage wet and smooth it into place with wet hands, being certain to obtain the desired outline form (Fig. 75 *d*)
9 Apply a plaster wash over this layer smoothing it well with wet hands.
10 Turn up both ends of the stockinet to form a lower border for the cap plastering the stockinet into the plaster wash
11 Insert traction appliances as indicated that is straps hooks, loops and so forth These must be placed to deliver the correct directional force in the individual case (Fig. 75 *e*)

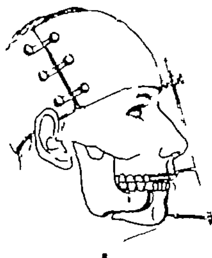
Figure 75 *f g* shows how one type of traction can be applied in connection with the head cap.

Kazanjian Plaster Head Cap A simple comfortable and adjustable head cap or bandage is used It embraces sound mechanical principles for forward traction of the mandible and may include the various types of fixation for either extra-oral or intra-oral splints.

The author is indebted to Dr Kazanjian for the following descrip-

tion of the cap construction the diagram illustrating one of its uses, and the picture of the patient wearing it.

A headcap for cranial fixation is most satisfactorily made of plaster into which the various attachments are incorporated for support of



a



b

Fig. 76. *a*, Diagram showing method of pulling the chin forward after sectioning of the bone. The median bar is anchored to the forehead and the upper teeth. A stainless steel wire (23 gauge) is passed around the symphysis and comes through the skin so as to form a loop in front of the chin. An elastic band extends from the wire loop to the bar in front. *b* The patient wearing this cap and traction apparatus. (Courtesy of Dr Kazanjian.)

intra-oral and external splints. Stockinet is placed over the head, and a layer of felt is wrapped around the head as a cushion. Moistened plaster bandage 3 inches wide is wrapped around the forehead and extended around the head below the occipital prominence. While this is being done various fixation attachments are embedded. As soon as a

of the ramus of the mandible This is generally followed by interposition of masseter or temporal muscle flaps to prevent regeneration of bone across the gap

TECHNIC OF OPERATION In recent years we have found the operation proposed by Risdon satisfactory It is especially useful when the coronoid process is involved in the ankylosis. An incision 1 to 1½ inches (2.5 to 3 8 cm.) long is made immediately beneath the lower border of the mandible starting just behind the angle and running forward. The incision is carried to the lower border of the bone. The soft tissues, including the insertion of the masseter muscle, are stripped away from the outer surface of the ramus almost as high as the mandibular (sigmoid) notch. A surprising amount of exposure of the outer surface of the ramus can be obtained by retracting the overlying tissues upward. With a sharp chisel, the ramus is now divided transversely just below the sigmoid notch, freeing the mandible The gap can be widened by further removal of bone above it, with a gouge or biting forceps. By exercising care it is generally possible to avoid injury to the underlying inferior dental nerve and vessels. Instead of the chisel a Gigli saw introduced around the ramus by means of the Blair, full-curved pedicle needle, can be used to cut through the bone with less trauma (Fig. 78 *a b*) A section from the detached lower end of the masseter muscle is now inserted in the gap in the bone, generally this section can be fastened with a catgut suture to the internal pterygoid muscle, lying on the inner side of the ramus. This interposition of muscle helps materially in preventing reunion of the divided bone The operation is attended with practically no danger of injury to the facial nerve It also has the advantage of better preserving the length of the jaw on the affected side

The use of a trismus appliance or exerciser (see p 107) after these operative procedures is helpful in maintaining or reestablishing functional movements of the mandible.

Malunion. Fractures of the jaws which have not been properly reduced and fixed may unite in the position assumed by the fragments after the injury This is particularly true in cases in which there is loss of substance The malunion may be fibrous or bony

General Treatment Malunion of the mandible is more easily corrected than that of the maxilla. It may be possible to reduce the fragments to normal position by gradual *elastic traction* if the patient is seen before consolidation has become complete. Fibrous bands can be cut and the fragments immediately reduced, and fixed in normal position by wires or splints. *Osteotomy* through the original line of fracture followed by reduction and fixation in correct position, is indicated if firm bony union in bad position has occurred. The *simplest conditions* to treat are those in which there has been no loss of bone and the ends of the fragments come into apposition after reduction. A *second operation* to supply new bone after osteotomy and reduction may be necessary if the loss is considerable

Osteotomy This is performed at the point of malunion A narrow

cient. The simplest of these is the ordinary wooden clothespin as suggested by Prinz. The ends of this are cut down to a sharp edge and inserted between the teeth. One of these devices can be given to the patient, who frequently will accomplish a great deal in a few days by its persistent use Great benefit may be obtained in more stubborn cases by regular application of a mild, interdental *elastic force* to separate the upper and lower jaws Figure 77 shows an apparatus which is effective for this purpose

APPARATUS FOR DILATING The two parts of the appliance are similar Each is partly composed of a flat metal tray which is passed between the occlusal surfaces of the maxillary and mandibular teeth The tray can be inserted if there is an initial opening between the anterior teeth of ⅜ inch (1 cm) or less. Heavy bars which pass out of the corners of the mouth and curve backward over the cheeks are soldered to the outer sides of each tray The bar attached to the upper tray on each side turns down at a right angle opposite the premolar region and ends in a hook about 3 inches (about 7 5 cm) lower down. The bar attached to the lower tray passes directly backward, horizontally and is provided with a hook at a point opposite the downward turn of the upper wire. The dilating force is a heavy elastic band placed between these hooks on each side This application of dilating force in the manner described is original with Darcissac. He however made individual apparatus from impressions in each case casting metal caps to fit the teeth. The advantage of the present appliance is that it is ready for immediate use in cases in which the oral opening would not permit of taking of impressions The elastic bands produce constant counteraction to the powerful elevator muscles of the mandible which at the same time are permitted to function. The upper and lower jaws are not fixed at any time Lateral movements, as well as opening and closing, are possible The trays can be filled with a little softened impression compound to receive the imprint of the teeth before insertion if additional stability is desirable The compound can be renewed from time to time The dilating force can be regulated by the size and tension of the elastic bands. The apparatus, which can be inserted by the patient, should be worn for fifteen or twenty minutes three or four times a day It usually produces a satisfactory result within a week or ten days.

Fixation by Scar Operative intervention may become necessary in the presence of fixation by scar in order to achieve the required opening of the mouth. Mere section or removal of the scar will not give a permanent result when an intra-oral scar involves the loss of the oral mucous membrane Raw surfaces must be covered immediately by flaps or grafts of skin in order to prevent re-formation of the scar tissue after intra-oral section or removal of scar tissue. When the fixation is attributable to external scarring, some form of plastic procedure on the soft tissues must usually follow excision of the scar

Bony Ankylosis In the presence of this condition the liberation of the jaw requires removal of a considerable section of the upper part

of the ramus of the mandible. This is generally followed by interposition of masseter or temporal muscle flaps to prevent regeneration of bone across the gap

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Osteotomy This is performed at the point of malunion. A narrow

chisel can be used but the operation can be accomplished with less trauma if a Gigli saw is used

Make a small incision through the skin not longer than ½ inch (about 1 3 cm.) along the lower border of the mandible at the site of malunion. Pass through this incision the full-curved pedicle needle used in circumferential wiring Keep it close to the inner surface of the bone and pass it through the mucous membrane of the mouth Carry a

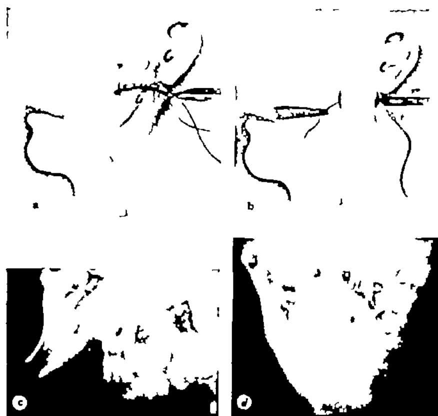


Fig. 78 *a* and *b* Osteotomy wire, passed around the ramus with a pedicle needle, used to draw the Gigli saw into position *c* ankylosis of mandible, right side; *d* osteotomy at site of ankylosis.

Gigli saw by means of a wire through the eye of the needle, against the inner surface of the bone, leaving one end in the mouth and the other emerging through the incision of the skin Section the mandible with the saw from within outward through the old line of fracture (Fig. 79)

Suture the cutaneous incision. This heals usually by first intention, leaving practically no visible scar Reduce the bone fragments and treat as a recent fracture.

Nonunion, with General Loss of Substance. A bullet or other foreign body traveling at high velocity generally shatters compact bone, such as the mandible, and may completely remove a segment. A foreign

body on the other hand may cause considerable shattering of the bone without much actual displacement and loss. The primary loss of bone may not be great, but a considerable gap may result later from infection followed by osteomyelitis and sequestration. Losses of large segments of bone of the mandible may be replaced by use of bone grafts.

Bone grafting for defects of the maxilla has not the equal value to grafts inserted in the mandible These repairs or reconstructions can be accomplished with fine ground cancellous bone injected with a syringe as previously described (p 42) Contour may be restored with fine diced cartilage introduced similarly (p 42) Cartilage can be implanted before or after the transfer of the tissue giving contour bulk and stability to the parts. Artificial appliances should be used when surgical repair is not feasible (Figs 106 114 115)

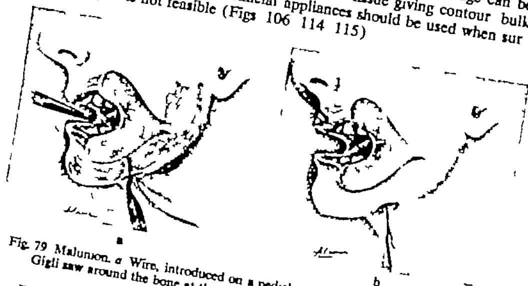


Fig. 79 Malunion. *a* Wire, introduced on a pedicle needle, will be used to draw the Gigli saw around the bone at the site of the malunion, *b* Gigli saw in use.

Bone Graft for Loss of Substance of Mandible It is often necessary to supply new bone from other sources in cases of fracture of the mandible if union does not take place by spontaneous regeneration of bone after a reasonable period of fixation of fragments Statistics from World War I indicate that about 11 per cent of gunshot fractures of the mandible resulted in nonunion and that bone grafting was required The nonunion is caused principally by the large loss of bone and the inability of nature to bridge the gap when the collapsed fragments are drawn apart and fixed in proper position In early treatment of fractures if proper fixation of fragments is accomplished and all viable bone particles are conserved in cases of comminution the necessity for bone grafts later is greatly reduced

The primary *object of treatment* is the restoration of function. To accomplish this, the former occlusal relation of the remaining teeth should be established and any loss of continuity of bone restored. It is never desirable to sacrifice the occlusion of the teeth to obtain union of the fragments (especially when good and serviceable teeth remain in

the fragments) for this cripples the masticatory function and increases external deformity

In cases of loss of substance of the mandible, preliminary treatment is applied to all adjacent fractures spontaneous union of which is expected. The fragments must be reduced and fixed in such position that normal occlusion of the remaining teeth is restored. All definite *foci of infection* should be eliminated. The removal or elimination of adjacent foci of infection such as roots of teeth projecting into the seat of the fracture other teeth showing evidence of periapical and periodontal disease, bony sequestra metallic foreign bodies, and infection in the soft tissues overlying the seat of fracture is imperative No operation to restore continuity of bone should be attempted until all evidence of infection and suppuration has subsided and a suitable period of time has elapsed after the closure of sinuses and septic wounds (three months)

Reduction is accomplished in cases of nonunion by manipulation and immediate insertion of a previously made splint which fits on the teeth and maintains the normal occlusal relationship It is possible occasionally to fix the fragments by means of wire ligatures attaching the lower teeth to the upper when a sufficient number of sound teeth are present. Types of splints and methods of wiring are described in detail elsewhere. The particular type of splint used depends, in large degree on the part of the mandible involved and on the relationship of the teeth present.

If the presence of *fibrous adhesions* prevents the manipulation of fragments into proper position for the application of splints, the adhesions *should be severed to permit their application* Since bone grafting is contraindicated as long as there is any possibility of contamination of the wound with oral secretions, severing of adhesions intra-orally before application of splints would defer grafting operations several weeks. This can be avoided in some instances by the gradual reduction of fractures to facilitate the application of splints. A similar circumstance exists in case of bony union of the fragments with loss of substance. The preliminary operation here consists in cutting through the bony union with a chisel or Gigli saw This operation requires cutting through the oral mucosa in nearly all cases. Bone grafting must be deferred until complete healing has occurred

Types and Methods of Bone Grafting of Mandible. Restoration of continuity was accomplished in many cases in World War I by using a *pedicled graft* taken from the mandible itself This method was first described by Bardenheuer in 1893 and was made widely known by Cole, of London. The method has had little use recently because it was found to produce undue distortion of the soft tissues of the floor of the mouth and neck, it is not suitable for large losses of bone especially in the region of the angle and ramus of the mandible It is considered also that the *cortex of the tibia* is unsuitable as a source of bone graft for the mandible because of its extreme density and consequent resistance to penetration of new blood vessels in the process of consoli

dation Fracture of the tibia after removal of a thick graft is not un known. *Rib grafts* have sometimes been used for these defects, but are usually too thin.

During the past twenty years the two methods have been (*a*) the *osteoperiosteal method* of Delagenière and (*b*) the *use of bone from the crest of the ilium* Each has fairly definite indications.

Osteoperiosteal Method of Delagenière (Fig. 34) ADVANTAGES The graft contains all the necessary elements for regeneration It is flexible it is easily adjusted to the size and shape of the defect the technic of its removal and application is simpler than that in any other method it produces no disability at the site of removal

DISADVANTAGES A longer time is required for consolidation and recovery of normal function than by other methods It cannot be depended on for maintenance of mandibular fragments during organization This form of graft can be utilized for repair of losses of any extent but we prefer to limit its use to losses not exceeding ¾ inch (2 cm) and to cases in which there is little change in facial contour

TECHNIC. Stage 1 Anesthetization of Patient and Preparation of Bed for Graft. Etherize the patient, preferably through an intratracheal tube introduced through the nose, without disturbing the fixation apparatus on the teeth stabilizing the fragments and holding them in proper position.

Over the site of the bony defect make a curved incision through the skin adequate in length and convex side downward, Dissect the included skin flap upward Turn up a second flap consisting of the soft tissues covering the bone Carefully remove all scar tissue to expose thoroughly the ends of the fragments of bone Exercise extreme care to avoid opening into the buccal cavity The operation must be abandoned if this accident occurs. Prepare a pocket, or cuff, around the end of each fragment by carefully stripping the periosteum and soft parts away from its inner outer and under surfaces for a distance of at least ⅜ inch (1 cm.) (Fig. 34 *d*) Freshen the exposed bone by trimming with a rongeur forceps.

Control hemorrhage in the usual manner and place warm moist gauze packs in the cavity while the graft is being taken and prepared. In case of excessive oozing, the gauze pack can be moistened with 1 5000 to 1 10 000 epinephrine solution.

Stage 2 Removal of Graft. Make a longitudinal incision of desired length through the skin down to the periosteum. Expose the antero-medial surface of the tibia. Outline the graft to be removed usually about 4 inches (10 cm.) long and ¾ inch (2 cm.) wide, by incision through the periosteum (Fig. 34 *a*) Carry this outlining incision into the bone to a depth of $\frac{1}{32}$ to $\frac{1}{16}$ inch (1 to 2 mm.) with a broad, thin chisel held perpendicular to the surface (Fig. 34 *b*) Remove the bone and periosteum included in the incision. Use the chisel bevel toward bone held nearly horizontal (Fig. 34 *c*) Cut the graft into the lengths desired. Close the skin incision.

Stage 3 Application of Graft Insert one piece of the graft, periosteal

surface away from fracture, with its ends in the subperiosteal pockets on the inner (lingual) sides of the mandibular fragments (Fig. 34 *d*) Insert a second piece of graft in a similar manner on the external (buccal) surface of the fragments (Fig 34 *e*) The bone surfaces of the two grafts now face each other across the gap A third piece of graft may be placed along the under surface of the fragments, if desired. Make certain that the bone of the grafts makes contact with the raw surfaces of the fragments Close the deep tissue flap over the grafts with interrupted catgut sutures (Fig. 34 *f*) Close the skin without drainage (Fig. 34 *g*) Apply a pressure bandage to immobilize the parts

POSTOPERATIVE TREATMENT The wound usually heals by first intention. Remove the skin sutures on the second to fourth day and support the wound with gauze strips applied with collodion Collections of serum are drained by opening the edges of the skin Avoid insertion of a drain if possible

Occurrence of suppuration in the soft parts may involve the graft, and healing may not occur until the graft is extruded Treat the suppurative process with appropriate chemotherapy internally and locally *Sulfathiazole powder* dusted or packed into the wound may promptly check the process. Resort to the usual local measures indicated.

Fixation of the jaws must be maintained until consolidation is well advanced, this requires at least eight weeks. Regeneration can be checked by roentgenologic examination at monthly intervals, but the final test of consolidation is clinical examination after disconnection of the upper and lower teeth.

Graft from Crest of Ilium. This procedure was first used in Germany by Lindemann and was the method of choice of Gillies and his coworkers at the Queen's Hospital at Sidcup England. Risdon and Ivy and Epes have described results of treatment by this method. This *type of graft is preferred* if the loss in the mandible exceeds ¾ inch (2 cm.) and, especially if the external contour of the face gives evidence of the deficiency (See *Bone One of the Supporting Tissues* p 32) The crest of the ilium furnishes a large piece of bone of porous structure closely resembling that of the mandible It is easily penetrated by new vascular supply and can be cut readily to suitable shape. The disability produced by removal of the graft is temporary and the danger negligible.

TECHNIC Stage 1 Anesthetization of Patient and Preparation of Mandibular Site Etherize the patient, preferably through an intratracheal tube introduced through the nose, without disturbing the fixation apparatus on the teeth stabilizing the fragments and holding them in proper position

Make an adequate curved skin incision convex aspect downward, over the site of the bony defect. Dissect upward the included skin flap Turn up a second flap consisting of the soft tissues covering the bone.

Carefully remove all scar tissue to expose thoroughly the ends of the bone fragments. Exercise extreme care to avoid opening into the buccal cavity The operation must be abandoned if this accident occurs. Prepare a pocket, or cuff around the end of each fragment by carefully stripping the periosteum and soft parts away from its inner outer and under surfaces for a distance of at least ⅜ inch (1 cm.) (Fig 34 *d*) Bevel the ends of the fragments of bone to produce a broad fresh surface Drill a small hole in the end of each fragment for the passage of a fixation suture of wire or gut (Fig. 35 *a*)

Measure the length of the required graft with a probe Control bleeding and place warm gauze packs in the cavity while the graft is taken and prepared. If oozing is excessive the gauze packs can be moistened with epinephrine solution 1 5000 to 1 10 000

Stage 2 Removal of Graft Make an incision down to the periosteum along the iliac crest on the same side as that of the mandibular defect. Separate the muscles from the external and internal lips of the crest (Fig. 35 *b*) Remove a piece of bone of the desired size with a metacarpal, or motor-driven saw (Fig. 35 *c*) Begin at the anterior superior spine and work backward. The graft comprises the full width of the crest, and should be of sufficient length and depth to fill the mandibular defect and to approximate the prepared surfaces of the fragments Approximate the detached muscles over the defect in the bone with interrupted catgut sutures. Insert a drain for serum if indicated Close the skin

Stage 3 Application of Graft. Remove any shreds of muscle but leave the periosteum on the graft. Drill a hole in each beveled end of the graft. The surgeon may find it easier to drill these holes before the graft has been removed from the ilium Pass wires (24 gauge brass or stainless steel) through the holes in the mandibular fragments and the graft. Twist the wires until the graft approximates the fragments firmly Cut the twisted wires short and bend the ends against the bone (Fig. 35 *d*) Secure the soft tissue flap with interrupted sutures of catgut. Close the skin with interrupted sutures.

The *postoperative treatment* is the same as that described under the osteoperiosteal method.

Block grafts of cancellous bone from the ilium are preferred by Blocker and other surgeons, bone chips from the same source by Mowlem and his supporters, and finely ground cancellous ilial bone (meal) by the author (see *Bone* p 42)

Fractures of the Maxilla

Trauma in the maxillary area frequently involves the *maxillary sinus* the *orbit* the *alveolar process* with *its teeth* the *buccal cavity* the *cribriform plate* at the nasal roof and more rarely the intracranial walls of the frontal sinus The laceration of the covering soft parts may or may not be considerable The median branch of the *seventh nerve* and *Stenson s duct* are frequently sectioned in lacerated wounds

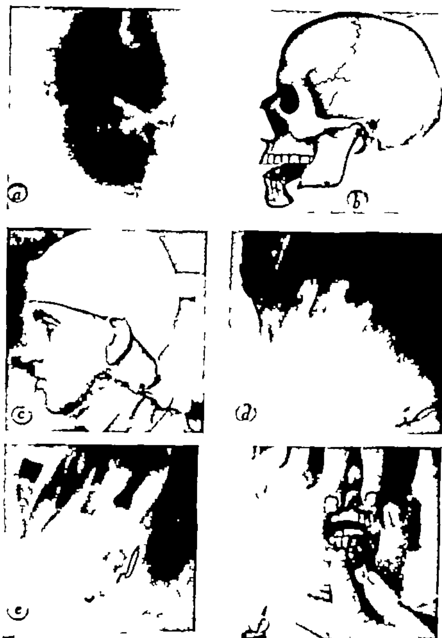


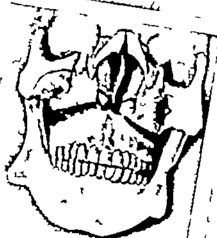
Fig. 80 a, Comminuted gunshot fracture of left side of mandible; b diagram of lateral mandibular defect, showing displacement of fragments; c plaster head cap and traction wire from posterior fragment, d roentgenogram showing traction wire holding posterior fragment in position also, extent of mandibular defect; e roentgenogram showing bone graft from crest of ilium filling defect of mandible; f patient after restoration of continuity of mandible, showing extent of oral opening and no lateral deviation of lower jaw



a



b



c



d





f

a through f Facial bones involved in connection wi[th] ... maxillae.

Fractures of the malar compound the upper part of the ramus and the condyloid neck often present serious complications with resulting ankylosis unless proper surgical care is rendered early

Control of hemorrhage provision of an adequate airway temporary approximate reduction and fixation of fragments are accomplished immediately along with the indicated care of the patient's general condition.

The fragile bones attaching the maxilla to the base of the skull may be crushed or destroyed as the result of severe trauma from below leaving the maxilla freely movable and held only by soft tissue. A rigid appliance to maintain the proper distance of the upper jaw from the base of the skull may be essential Other means, such as wires coming down in front of the face from a head cap the wires connecting with a splint on the teeth can be improvised.

General anesthesia may be necessary for reduction of extreme displacement associated with fractures before application of the fixation apparatus. This part of the management of a fracture of the jaw can be instituted soon after the patient's admission to the hospital, before permanent repair of the soft parts is possible Repair of soft parts after a few hours must await subsidence of infection therein and in the bone

The desired result in cases of bilateral transverse fracture of the upper jaw with backward displacement, may be accomplished by traction by means of one of the methods previously described (Tongue Depressor Method, p 94 or Coat Hanger Method, p 95) Fixation of the upper and lower teeth in occlusion may be all that is necessary to complete the treatment. This can be accomplished with multiple loop wiring and elastic bands according to the amount of stability required in the individual case.

Displacement. Displacement of fragments in fractures of the maxilla is not necessarily due to muscular pull, owing to the absence of powerful muscular attachments but rather to the traumatizing force and to gravitation (Fig. 82)

Unilateral Fracture of Maxilla This is caused usually by direct force coming from in front or from one side The entire maxilla on the affected side sags and may be forced inward with overlapping of the palatine suture. Occasionally the fragment will be forced outward, causing spreading of the midpalatine suture

Bilateral Horizontal Fracture This is caused usually by direct force from in front, such as that exerted when the face strikes the framework of a suddenly arrested automobile or is struck by moving equipment in an industrial plant, e.g a moving crane The force carries backward the entire maxilla, somewhere above the level of the palate and gravity causes it to sag posteriorly The posterior upper and lower teeth can be brought together while there is an open bite in front. The upper anterior teeth are distal to their normal or original position.

The author chooses to fix large fragments in the presence of in

cised wounds of the soft parts by direct wiring with steel or bronze or prefers fixation with No 1 chromic gut, which relieves the necessity of later removal The procedure is particularly desirable at the orbital junction of the malar in the region of the malar zygomatic articulation and the frontal nasal process.

Losses of the alveolar process, lateral and anterior walls and parts of the palatine bone are reconstructed with pedicled skin flaps trans

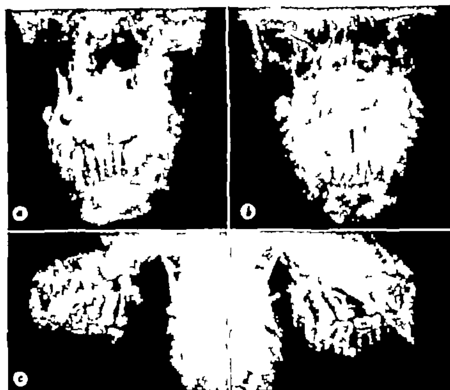


Fig. 82. *a*, Fracture of the maxilla, compound complete, through the lateral and medial walls of the maxillary sinuses and nasal structures; displacement distally and to the right fracture of the mandible, compound region of right canine and left canine teeth fragment displaced distally simple fracture of neck of condyloid process, left side· *b* lower arch restored to former contour in early treatment, and superior maxillary fracture reduced and immobilized later by application of intramaxillary multiple loop wiring, using elastic bands for intermaxillary traction and fixation, *c* and *d* former occlusal relation of right and left sides restored also, fracture of left zygomatic arch reduced.

ferred on the wrist as a carrier in preference to dentures with solid or hollow acrylic extra-oral obturators. The area of bone loss may be strengthened by the addition of block diced or shredded cartilage if this is necessary for the retention of an ordinary denture (see p 131 and Fig 39)

The excellent discussion of this subject by Ehrich and Austin in the *Atlas of Treatment of Injuries of Facial Bones* is commended to the reader

Fracture of Nose

Do not manipulate or "pack" a nose in the presence of drainage of cerebral fluid Wait a minimum of ten days after draining ceases.

Reduce the fracture immediately if possible but remember that it can be done at any time in the course of two or three weeks and that failure to reduce a fresh fracture requires extensive surgical measures later The nose is the most prominent facial feature Marked abnormalities create a definite economic and psychic hazard

Do not neglect the intranasal condition. Failure to do corrective work necessitates surgical procedures at a later date

Diagnosis. Frequently difficult, immediately

1 Generally, much swelling when first seen This masks the extra nasal and intranasal displacement.

2. Tenderness prevents adequate palpation.

3 Roentgenologic procedures are neither particularly useful nor necessary in most cases.

4 If uncertain as to diagnosis wait until the swelling has subsided.

5 Examine both the external and internal aspects of the nose for displacement and movement. The fracture is *frequently* compounded intranasally or at least, the mucosa is torn in some part of the line of fracture.

Factors Producing Fracture. The displacement of bone and cartilage depends on the *mass and shape* of the traumatizing object and the *force and direction* of the impact

Objects having flat contacting surfaces, weight, and a considerable force may produce displacement, and impaction or comminution. These objects and those with irregular and sharp surfaces lacerate the soft coverings Small objects tend to produce local fractures

The direction of the force determines the lines of displacement. Such force may be *lateral*—at a right angle to the side of the nose *anterior*—perpendicular to the nasal ridge, *inferior*—from below in the line of the long axis of the nose (septum and nasal bones) or in a combination of these directions.

Fracture Resulting from Lateral Force Nasal (frontal) processes of the maxilla are fractured at their bases and the suture line with the frontal and nasal bones The nasal (frontal) process proximal to the blow is carried toward the median line to create the typical long (flat) side and the distal process is carried laterally to create the short (perpendicular) side (Fig. 83 see also Fig. 87) The nasal bones (en masse) are somewhat rotated and carried in the direction of the force either to lock under or to override the fractured edge of the nasal (frontal) process of the distal fragment.

The nasal septum (perpendicular ethmoid plate) is carried laterally with the nasal bones to constrict the upper half of the airway It frequently suffers multiple fractures and is separated from the vomer The cartilaginous (quadrilateral cartilage) portion is bent or fractured (greenstick) with the nasal bones and becomes dislocated from its

groove in the vomer This produces the S-shaped nasal ridge typical of this type of fracture and distortion of the columella and nostrils

Fractures Resulting from Anterior Force TYPE 1 The nasal bones may be comminuted, compounded or displaced posteriorly en masse (flat nose) as shown in Figure 84

TYPE 2. The nasal (frontal) processes of the maxillae may be fractured along their articulations with the nasal bones and become rotated outward from fracture lines at their bases ("bursting force") (Fig. 85) They may suffer multiple fractures and be driven posteriorly with the nasal bones (flat nose with upturned nostrils)

TYPE 3 The nasal septum suffers multiple compound fractures in both the bony (perpendicular ethmoid plate) and cartilaginous (quadrilateral cartilage) portions The fractured fragments frequently over

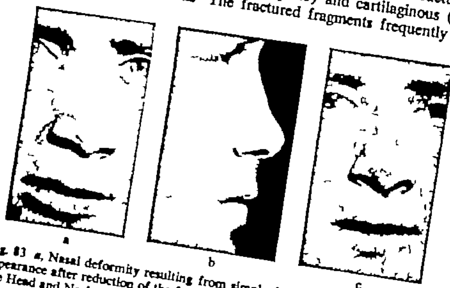


Fig. 83 a, Nasal deformity resulting from simple fracture (lateral force) b and c appearance after reduction of the fracture. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

ride. The cartilaginous septum may suffer greenstick fracture and become dislocated from its groove in the vomer

TYPE 4 The cartilages of the tip upper and lower lateral may be dislocated or fractured (Fig. 86)

Fractures Resulting from Force from Below The displacements are similar to the foregoing. The nose is "pushed back" or flattened.

In Types 1 2 and 3 the cribriform plate of the ethmoid bone and the sphenoid bone are frequently fractured with resulting drainage of cerebral fluid.

Reduction of Nasal Fractures: *Anesthesia* The interior of the nose is sprayed with equal parts of *cocaine hydrochloride* (20 per cent) and *epinephrine hydrochloride* (1 1000) The resulting solution is cocaine hydrochloride (10 per cent) in epinephrine hydrochloride (1 2000) Five minutes after spraying, the nose is gently packed with cotton pencils wrung out of solution. The pencils are placed well upward and

backward, as well as along the lower turbinal bone. If the degree of swelling permits cotton wound applicators, saturated with epinephrine hydrochloride (1 1000) and rubbed in cocaine powder may be sub-

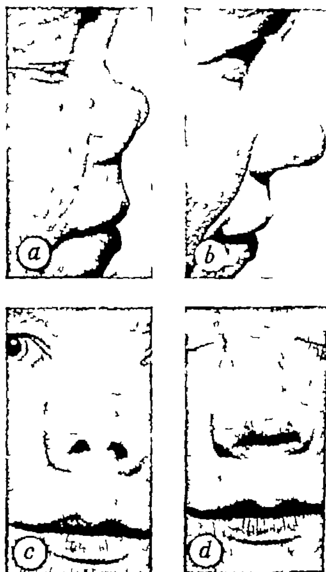


Fig. 84 Deformity resulting from compound fracture of the nasal bones and nasal processes of the maxillae (force exerted anteriorly and inferiorly) *a*, Lateral view before and, *b* after reduction, *c* anterior view before and, *d* after reduction.

stituted for the cotton pencils. One is placed over the region of the sphenopalatine ganglion (posteriorly superiorly and laterally) and the other upward against the cribriform plate between the midportion of the middle turbinate bone and the septum (anterior ethmoidal nerve) A cotton pencil is placed on the nasal floor anteriorly to anesthetize

filaments from the anterior palatine nerve The external soft parts are anesthetized with 0.5 per cent solution of *procaine* injected at several points along the bases of the nasal (frontal) processes



Fig. 85 Deformity resulting from comminution of the nasal bones and nasal processes (direct anterior "bursting" force) Both nasal processes are displaced laterally *a*, Anterior and, *b* lateral views before reduction and reconstruction *c* anterior and, *d* lateral views after reduction and reconstruction. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Procedure

1 Disjoin and segregate the several bony fragments of the nasal arch.

2 Elevate and straighten the nasal septum Return the cartilage to its groove in the vomer

3 Rotate the nasal (frontal) processes inward and mold them into normal contact with the nasal bones.

4 Use light intranasal packing, *if required* and an external splint (Figs. 87 88, 89)

Asch forceps with rubber tubing over the blades to protect soft parts and any strong, thin-bladed spatula will suffice for *manipulation* (Fig. 88) One blade of the forceps is introduced intranasally on either side the fragment of the nasal process is grasped firmly and rotated outward. In the presence of posterior displacement of the nasal bones and impaction the blades of the forceps are introduced first intranasally one on either side of the septum and traction is applied upward and forward. The blade of a spatula is useful in this maneuver In the event that the frontonasal articulation of the nasal bones has not been frac

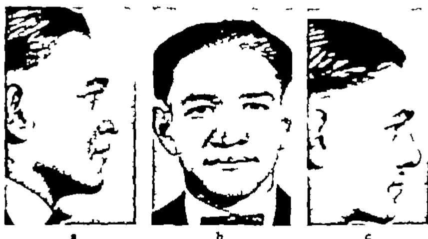


Fig. 86. *a* and *b* Fracture and displacement of the quadrilateral septal cartilage and the right alar cartilages (direct anterior force) *c* appearance after reduction and reconstruction. (Ferris Smith *Reconstructive Surgery of the Head and Neck.* Thomas Nelson and Sons.)

tured until these bones are freely movable, it may be necessary to make a stab incision with a small knife over the glabella and free the bones with a small beveled chisel. The nasal (frontal) processes may now be rotated outward. The nasal septum is straightened and replaced in its groove in the vomer by manipulating and lifting forward and upward with the Asch forceps. A long-bladed nasal speculum is a useful aid in this connection. The nasal (frontal) processes may now be rotated inward and molded into normal contact with the nasal bones.

Light packing with iodoform ribbon gauze may be required to control oozing and to maintain the parts in position. A cotton eye pad is fitted externally to the nose and covered with a copper sheath splint. This is maintained by an inch-wide strip of adhesive tape Squeeze the cheeks toward the nose before applying the adhesive tape. This provides sufficient tension to hold the splint and allows for swelling (Fig. 89) Remove the packing in twenty four hours.

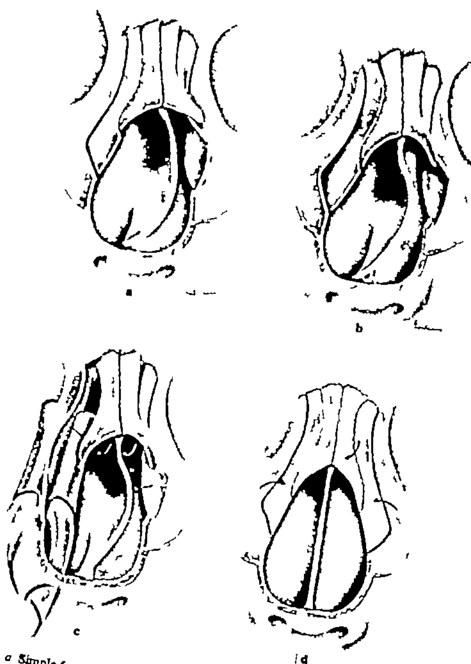


Fig. 87 *a* Simple fracture and lateral displacement of the nasomaxillary articulations and the bases of the nasal processes of the maxillae (lateral displacement) displacement of the nasal septum. *b* Impacted fracture of the nasal bones and nasal processes of the maxillae (lateral displacement) *c* Asch forceps with one blade externally and one blade intranasally grasping the nasal process of the maxilla the arrows indicate the direction of traction for reduction of the fracture. *d* Replacement of the fractured elements, normal bony arch.

Clear the nose daily with a suction pipet. *Do not sponge it internally* Inspect the septum after twenty-four hours for hematoma and drain promptly if it occurs Do not allow the patient to blow his nose



Fig. 88 Asch forceps.

for ten days. Permit him then to *blow both sides at once* without undue force Remove the splint permanently at the end of a week or ten days and instruct the patient not to handle his nose



Fig. 89 a, Application of a copper nasal splint over a thick, cotton eye pad this is fixed in position by a strip of adhesive tape applied to the cheeks after the tissues of the cheek have been moved toward the nose. The traction of the displaced muscles of the cheek provides suitable tension. *b* Piece of shaped copper sheet (20 gauge) covered with waterproof adhesive material. This is cut from a paper pattern of the nose.

Fracture of Zygomatic Bone and Arch

The *incidence* in civil life is 1 3000 cases of fracture of bones of the face.

This bone (malar or "cheek" bone) forms one of the most prominent parts of the facial contour It is dense and not readily fractured itself. It forms the lateral wall, part of the anterior wall, and part of

the floor of the orbit, and with the zygoma forms a buttress supporting the maxilla.

Articulations. Four sites of fracture correspond to the articulations of the bone (1) the frontal process—superior external orbital margin (2) the orbital process—region of intra-orbital foramen (3) the zygomatic arch (4) zygomatic process of the maxilla—anterior antral wall.

Sites of Fracture. The zygoma may occasionally suffer simple fracture of the suture lines and remain in situ It may be *displaced* as follows

1 Simple displacement of various degree
2 Outward (force posteriorly on the zygomatic arch)
3 Medially and superiorly (force laterally and upward) Fracture occurs in the region of the infra-orbital foramen The point of the fragment may be palpated near the inner canthus
4 Backward, downward and inward (force laterally and downward) This is a common displacement. The articulation with the maxilla remains intact, and a comminuted impacted fracture of the thin outer wall of the maxillary sinus occurs. The zygoma sometimes occupies the posterior part of the antrum

Diagnosis. This is based on the history local appearance palpation and roentgenologic appearance which develops the *signs* and *symptoms* enumerated below

1 Facial swelling
2. Depression or distortion of the locality (flatness of the face above and fulness below)
3 Limitation of motion of the mandible resulting from muscular spasm (trismus) mechanical obstructions (depression of the zygomatic arch against the coronoid process) and pain
4 Ecchymosis
5 Unilateral nasal hemorrhage (laceration of the lining of the antrum
6 Infra-orbital anesthesia (injury to the infra-orbital branch of the fifth cranial nerve in the foramen or body canal)
7 Diplopia (displaced orbital rim and floor with relaxation of the extra-ocular muscles)
8 Emphysema (lacerated antral lining)

Reduction and Management—General Comment. This has for its purpose the restoration of normal function to the mandible and the eye and normal facial contour

Reduction should be accomplished as early as possible in order to avoid the difficulties offered by the soft tissue reaction and the early fixation of the fragments. If immediate reduction is contraindicated it should be accomplished *within two weeks* in order to avoid an open procedure

Methods of Reduction (Fig 90) *Matas* passes a curved cutting needle with a stout suture from below upward around the zygomatic arch and uses this to pull through a silver wire which forms a sling

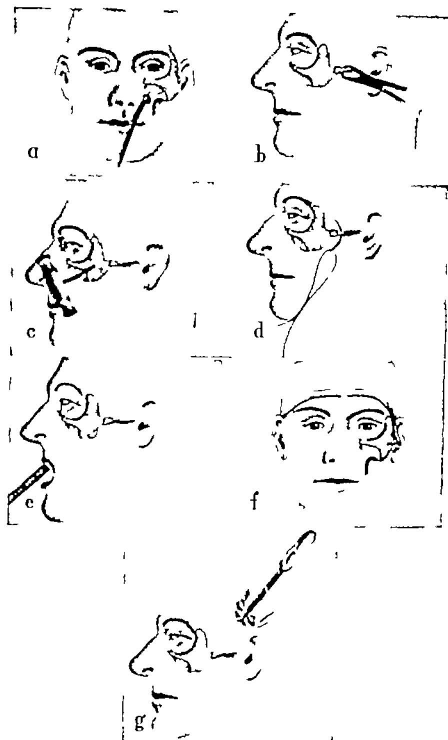


Fig. 90. Methods of reduction of fracture of the zygomatic bone and arch. *a* Antral approach (Lothrop) *b* external approach (Manwaring-Gill) *c* external approach (Roberts) *d* external approach (Matas) *e* intrabuccal approach (Keen) *f* skeletal traction (Ivy Curtis) *g* temporal approach (Gillies and Kilner)

around the bone Traction is applied. A splint along the arch is held in place by twisting the wire over it.

Manwaring-Gill grasps the fragment with a towel clip or cowhorn dental forceps, and manipulates.

Roberts makes a small incision over the bone and inserts an instrument like a corkscrew into the bone for traction and manipulation. This is the method of McCurdy (1923) who used a double wire coat hook.

Ivy and Curtis make a small incision over the bone drill a small hole in it, and insert a 1 inch ordinary screweye for manipulation A plaster head cap (Scogin see Fig. 75) containing a side arm of heavy wire is fashioned for use of elastic-band traction (see Coat-hanger Method p 95 and Figs 70 71)

For an intrabuccal approach, *Keen* makes a small incision in the buccal fold and inserts a heavy blunt instrument under the zygomatic process for elevation and manipulation

For a temporal approach, *Gillies and Kilner* make an incision in the hairline above and in front of the ear incise the temporal fascia, and pass a curved instrument downward and forward under the zygomatic bone. The skull acts as a fulcrum to permit levering the fragment into place.

For an antral approach, *Lothrop* incises the soft parts along the canine fossa to allow an instrument to be introduced into the antrum He clears out loose fragments of bone and clot and elevates the fragment with a heavy instrument.

Management The procedures of *Gillies* and *Kilner* or of *Keen* will suffice in all ordinary cases The former procedure is conducted through a clean field and is less likely to be followed by infection It offers better leverage for reduction The authors' description is as follows "A curved incision 1½ inches long, is made over the temporal muscle and well within the hairline The edges are retracted a small incision is made in the temporal fascia and a long, thin elevator is passed downwards on the surface of the temporal muscle until it lies deep to the displaced bone When the lever is inserted in the correct fascial plane it slips under the depressed bone in the most convincing manner while the operator's hand rests on the firm support given by the skull. The latter should be protected from local pressure injury by a large gauze pad By careful levering movements the whole bony mass is elevated into correct position a finger on the various points referred to previously is used as a guide to determine when this result has been achieved"

In those cases wherein the fragments will not remain in place the method of traction described by *Ivy* and by *Curtis* is used. The plaster cap (Scogin) which is cumbersome and uncomfortable (Fig. 75) is replaced by the simple ingenious traction apparatus of *Stout* and *Kazanjian* (Fig. 76) The posterior attachment to the head bandage is shifted laterally to permit a direct pull on the screweye. Traction for four days to a week generally will suffice to locate and fix the fragments in place Direct wiring is rarely necessary

A certain group of cases are best managed by *transantral methods* (Lothrop Fig. 90) (see Orbital Reconstruction, Figs. 288 289) *Packing* in the antrum for a period of days is not approved. Moderate packing for twenty-four to forty-eight hours may be essential in an occasional case All bone with any attachment is to be conserved and replaced

A *drainage* opening through the naso-antral wall anteriorly beneath the lower turbinal bone, is provided and the incision closed with horizontal mattress sutures gently tied. The stitch line is painted with com pound tincture of benzoin A compression pad is placed below the malar prominence and a firm bandage applied about the face and head.

It is sometimes necessary in old cases to cut down on the lines of fracture and separate them with a chisel In these cases wiring fre quently is required.

Multiple Fractures

These are of least common occurrence and require the best *co-operative planning* with the dental surgeon (Their management requires a combination of the considerations in the section on Maxillary Surgery) *Do not manipulate these fractured fragments in the presence of fractures of the base of the skull and accompanying injury of the brain until drainage of fluid has ceased and the patient s condition approximates normal*

Complications

These comprise injury to nerves such as the infra-orbital and seventh cranial section of Stenson s duct injury to the eyeball or extra-ocular muscles nasal fractures with loss of bone and injury to the maxillary sinus with hemorrhage Wash out the clot through a liberal intranasal opening *do not exert pressure* (see Meloplasty pp 308 309)

Loss of Bone

This is accompanied by loss of soft parts and essential structures such as motor nerves, muscle the eye the nose and the tongue. The soft parts can be reconstructed the bone can be replaced by graft or the contour restored with diced bone or "meal" cartilage or dermal graft motor nerves can be grafted if presence of the nerve is required the eye can be replaced by a prosthesis in a properly prepared socket (Fig 287) or the orbit blanked (Fig. 442) the nose can be rebuilt, and the tongue can be repaired to the extent of its remaining parts only

Loss of bone which is not properly managed shortly after occur rence and unreduced fractures of the malar compound with displacement, result in a distressing cosmetic disability Surgical readjustment is impossible a few weeks after trauma.

The facial contour may be restored by several procedures implantation of carved cartilage blocks successive dermal implants by diced

or shredded cartilage by bone chips or ground bone meal. The latter are the procedures of choice depending upon the age and status of the patient.

The cartilage may be placed as is to be described (p 132), and molded and dressed with a previously prepared contour dressing splint of acrylic resin.

The bone meal is introduced through an old scar or one or two new ¾ inch incisions The soft parts are elevated by blunt dissection above the periosteum. Three or four small bone areas are denuded and freshened with a currette or a side-cutting burr These are adequate for bone union and fixed support.

The meal is introduced under the separated soft tissue with a pressure syringe (p 42) and molded and dressed as just described The dressing is maintained for two or three weeks

CARTILAGE, ONE OF THE SUPPORTING TISSUES

This is frequently the material of choice for nasal support reconstructions of the ear and certain restorations of contour about the face chin mandible orbit and supra-orbital region. It is useful for protection in small losses of the skull Cartilage does not unite with bone but is encapsulated in scar As a rule adult cartilage remains unchanged if the perichondrium is removed.

Autogenous (same person) *homologous* (same species) and bovine cartilage are usable Autogenous cartilage is obtained from the free and fixed ribs for ordinary use and from the ear itself for some otoplastic procedures

Homologous cartilage has been used satisfactorily for many purposes during the past fifteen years It was used for nasal reconstruction occasionally during World War I This long experience has proved its retention and safety The ease of its procurement, preparation and storage frequently prohibits opening the patient s chest to obtain autogenous material It is gathered in the morgue under aseptic conditions from subjects who have met with traumatic fatalities and who were free from infection.

Wardill and Swinney advocate the use of bovine ensiform cartilage removed under surgically clean conditions stripped of perichondrium boiled for one minute and preserved like homologous cartilage

The cartilage is preserved as follows Either cartilaginous ribs or ensiform cartilage is obtained under sterile or unsterile conditions and stripped of its perichondrium It is thoroughly washed with ordinary tap water to remove blood which may have collected on it. This material is placed in a covered, sterile glass container and covered with a solution of one part of aqueous merthiolate (1 1000) to four parts of sterile normal saline The solution should completely cover all the cartilage by at least 1 inch. The container is placed in the refrigerator and left there It is taken out only when the solution has to be changed or cultured or the refrigerated cartilage used for grafting purposes. The

solution on new material is drained off and changed twice a week for two weeks and then only once a week thereafter It is advisable to culture the merthio-saline solution each time that a piece of refrigerated cartilage is to be used for a reconstruction This satisfactory method of antisepsis and preservation was described by O'Connor and Pierce after five years of use in 1938 They had used satisfactory homologous car tilage preserved for two years.

Peer used strips of cartilage for contour construction but abandoned them for obvious reasons and undertook its use in small bits ("diced")

The objections to strips, as well as thicker blocks are that they are not fixed the encapsulating scar permits motion and the late scar contraction between the strips produces irregularities of contour Peer covered these strips with dermal graft without satisfaction.

The diced cartilage consisted of multifaced bits of 1 to 4 mm. He reported in 1943 seven cases done during the previous five years in which the bits of autogenous and homologous cartilage had been stored experimentally under the skins of seven patients These were removed at intervals and sectioned. The bits had contact with each other and were encapsulated in fibrous tissue, thus making a fixed total mass. The fibrous capsule contains blood vessels

The autogenous bits presented well-nourished cells normal matrix and no evidence of absorption.

The autogenous cartilage is the choice, when feasible especially in young children because young cartilage grows.

Homologous living cartilage from patients with normal blood and physical findings may be used largely inert (foreign body) after proper sterilization and storage.

Peer used this diced cartilage for restoration of contour and in bone losses. The preparation was made through large incisions, and implant was frequently made under thin covering. This tended to allow extrusions from large implanted masses.

DeKleine prevented the latter and added ease to the procedure by freeing the soft parts through a small incision He devised a strong syringe with a cannula permitting passage of the diced bits and allowing easy distribution of the required mass under the dissected tissue (Fig. 91)

The author prefers much finer bits—a shredded cartilage divided in fractions of a millimeter The shredding is accomplished by passing pencils of cartilage over the cutting cylinders of a pencil sharpener These are enclosed in a metal housing. The shreds drop into saline solution and are readily introduced into the barrel of a metal syringe We prefer the former screw piston type of syringe used for paraffin injection and a small bore needle or cannula. The great pressure of the piston cuts the shreds into fine bits as they are driven into the needle. The same type of syringe is used for the injection of cancellous bone meal

A small nasal saddle may be corrected without dissection by introducing a sharp needle under the skin and properly molding. Larger

saddles require separation of the skin through a small stab incision and blunt dissection The cartilage is introduced through a small cannula.

The mental part of the mandible—the chin—may be supplemented, extended and molded in a similar manner through a small (⅜ inch) submental incision to the periosteum with separation at this level and proper molding and dressing.

FAT; FASCIA

Fat has little use as a free transplant The fact that the amount of absorption is unpredictable precludes its use as a filler for depressed

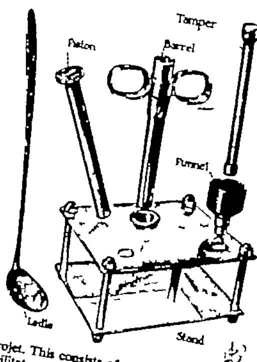


Fig. 91 The Chondrojet. This consists of a barrel with finger grips and a piston. A perforated ladle facilitates handling of diced cartilage. The stand, funnel and tamper are used for loading.

contours. It is extremely useful when shifted locally and with attachment to prevent the adhesion of a suture-line scar to underlying soft tissue or bone or both, and when it is transferred with a pedicled flap to cover tendons and muscles. It may be used successfully in this manner as a filler to restore contour

Peer recently reported a research in which both autogenous and homologous grafts were implanted beneath the sheath of a rectus muscle in thirteen cases Half of the weighed fat mass in each case was planted in small pieces and the other half en masse The implants were removed, weighed and examined in three to fourteen months Peer observed the obvious fact that homologous implants were entirely replaced by fibrous tissues that the autogenous grafts were encapsulated by

fibrous tissue which limited blood supply and that the small pieces showed a 79 per cent and the single mass a 45 per cent loss of weight and volume in twelve to fourteen months. These findings are similar to those of clinical observations.

Fascia has its principal use as a strong, nonabsorbable, nonadhering and nonelastic supporting material It is used chiefly for support and



Fig. 92. Fascial strippers.



Fig. 93 *a*, Method of introduction of a dermal graft. *b* Introducing tube slotted to permit removal, and long cutting needles for introduction through hidden incisions and implantation at a distance, for example, lower forehead, infra-orbital area, and so on.

fixation in the mechanical balancing necessary in cases of unilateral facial palsy It is obtained from the fascia lata by the use of stripping instruments introduced through a small skin incision which permit the cutting of strips the entire length of the thigh (Fig. 92)

The incision, 2½ inches (about 6 cm.) long, is made above and lateral to the knee and the fascia is cleaned of fat as high as possible. A strip of the desired width is engaged as low as possible and cut up to the tensor fasciae latae It is severed with the stripper if it has a cutting device or through a small skin incision Three or four pieces of fascia of the required lengths are removed in this manner

DERMAL GRAFT

This is the most useful transplant for correction of the contour of nonrigid regions (nose eyelids, face lips and supra-orbital region) The graft is easily obtained and transplanted. It can be cut to the desired shape and planted in double layers The procedure may be repeated as often as necessary to obtain a perfect restoration. The graft organizes into scar which remains flexible (lower half of nose sunken eyelids after trophic absorption of orbital fat, and so forth) It rarely gives trouble though sebaceous cysts may form in undegenerated glands. These may be dealt with readily

Peer examined grafts implanted from seven days to a year He found that the sebaceous glands and hair follicles usually disappear entirely Remnants of epithelium first form small cysts and ultimately disappear The graft remains as living tissue.

The desired skin is outlined on the abdomen, thigh or arm and its epithelium shaved off with a skin-graft knife or razor (thick Thiersch graft) The remaining corium is dissected free from fat. This graft, or two layers of it as required is introduced into a tunnel prepared under the skin through a small neighboring incision A stout suture (dermal) threaded into a long needle on each end, is passed through two end corners of the graft. The needle is introduced beneath the tunneled skin through special tubes to guard the needle point (Fig. 93 *b*) and brought through it at appropriate points at the distal end of the tunnel. The graft is drawn into the tunnel, and the threads are removed. They may be tied over rubber tube pads and retained safely for two days The skin incision is closed and a firm, gauze dressing applied over the area. This is maintained for several days until adhesion and nourishment of the graft are assured (Fig. 93)

Absorption of 10 to 20 per cent in volume should be anticipated.



Chapter III

GENERAL SURGICAL PROCEDURES AND TREATMENT

TREATMENT OF THE SEVERELY BURNED PATIENT*

Extensive injury to the body caused by heat applied any way is always serious and carries a high morbidity and mortality The sudden production of a large wound is soon followed by pathological changes in every organ and in every physiological function. Intensive studies of these abnormalities have been made in many laboratories and clinics. A better understanding of them has resulted in more satisfactory treatment. Many aspects of these body changes remain unsolved, however as well as those of treatment. The literature on this topic is voluminous, but only those references will be cited that seem fundamental to a compact and practical presentation of recent trends in treatment. The problems encountered in burns and their treatment will be given in the sequence in which they most frequently occur Physiological mechanisms involved and the experimental evidence for the therapy advised will be given where such seem appropriate.

Admission Appraisal of the Patient. There is an admission appraisal of the general condition of the patient, attention being directed particularly to conditions necessitating immediate or subsequent intervention such as

1 Respiratory obstruction
   (a) Laryngeal or tracheobronchial edema secondary to inhalation of flame or noxious fumes

*By Henry J Lange M D Kenneth N Campbell, M D., and Frederick A. Coller M D

(b) Foreign bodies (such as vomitus)
(c) Massive, acute pulmonary edema (usually occurs several hours after the burn) When necessary tracheotomy must be carried out without delay
2 Concomitant injuries
(a) Those producing serious hemorrhage or tending, in them selves, to precipitate severe shock (fractures, internal injuries, and so forth)

These factors will vary with the time interval elapsed since the burn was sustained and their treatment is that of the complication plus that of the primary lesion.

Prevention and Treatment of Burn Shock: *Management of Anoxia* (see Fig 94 page 150) The four recognized types of anoxia (anoxic anoxia with pulmonary edema, anemic anoxia with secondary anemia, stagnant anoxia with shock, and histotoxic anoxia with improper medica tion [narcotic drugs] and carbon dioxide poisoning) may occur in the se verely burned patient if care is not taken to prevent or ameliorate them This important phase of shock management is frequently overlooked Not only is it important from the standpoint of disturbed organ func tion but it is also well known that certain organisms, such as beta hemolytic streptococci, multiply faster in the presence of even a slight anoxia.

The therapy to be instituted which has priority over every other con sideration lies in the correction and maintenance of an adequate air way

Oxygen administration in some form is almost a necessity in every severely burned patient when shock is impending or being treated It may be administered by mask (B L.B)—tent or nasal tube Where feasible oxygen given by mask is the method of choice. It affords full saturation of available hemoglobin and, in addition, gives an added slight advantage from the oxygen dissolved in the plasma. The advantage of not having a tent to contend with early in treatment is obvious, since nursing care is more efficient in the absence of a tent, and the physician in charge can follow the patient's course more adequately

The rate of flow of oxygen should be maintained at 6 5 to 8 liters per minute It should be remembered that tents vary considerably in their efficiency and in many instances are inadequate

It has likewise been deemed inadvisable to administer oxygen under positive pressure in most cases The dangers attending this procedure outweigh any advantages over the usual methods of administering oxygen.

If an element of carbon monoxide poisoning is present or suspected, a continuous stream of oxygen containing 5 per cent carbon dioxide is advisable to aid in the elimination of the carbon monoxide

Environmental Temperature of the Patient The practice of treating patients in "burn tents" and "burn rooms" is often as harmful and il-logical as the old "ether bed."

Rapid heating aggravates shock in many instances by immobilizing available circulating blood in a reservoir of peripheral vasodilatation

There is evidence to show that a reduced temperature of the trunk and extremities of a burned patient may exert a protective effect. Theoretically two facts appear significant (*a*) Locally cold is known to inhibit pain edema infection shock toxic absorption and tissue devitalization (*b*) these are precisely the processes that need to be overcome in burn treatment.

Experimental evidence as well as clinical favors a room temperature of 70 to 80° F The patient's comfort may be relied upon in controlling room temperature but should the patient be unconscious there is no reason to suppose that any more external heat is necessary than would be required by a normal person lying in bed

In tropical climates, and during hot days in the temperate zones *actual cooling or air conditioning will prove helpful*

On hot humid days, massive occlusive dressings may so reduce dissipation of heat that the patient's life may be endangered unless some means of heat dissipation is provided.

The factor of fever will definitely increase metabolism and produce increased nitrogen breakdown and excretion The rate of increase in metabolism will vary from 7 to 13 per cent per degree rise in temperature

Immediate Care of the Wound The burned surfaces are covered with sterile towels or preferably the patient is placed between sterile sheets All the attendants and the patient are masked The bacteria count is usually low on burned surfaces seen early The chance of contamination often occurs after treatment has been instituted.

Infusion Procedure Intravenous equipment is set up Hartman's solution or 5 per cent glucose in water is started if blood is not immediately available

The smallest and most distal veins of an upper extremity are selected as the site of infusion. The reason for this becomes apparent within a few days when there are no longer any sites available for infusion A "cut-down" exposure of collapsed veins may be necessary and in some cases becomes a life-saving procedure

Control of Pain The use of morphine should be restricted to adults, and the dosage minimized It should not be used if there are serious chest or head injuries Only codeine is recommended for children Hyperactivity of the patient if present may be due to fear hysteria or cerebral anoxia rather than to pain from the burn site The dangers attending the use of morphine in the presence of cerebral anoxia need no comment

Morphine is assuredly a sovereign remedy for pain but even so it is usually given in excessive doses. For analgesia small doses (10 mg — 1/6 grain) given subcutaneously or intramuscularly are usually sufficient. It has been demonstrated that larger doses give little additional analgesia yet greatly augment undesirable effects particularly respiratory depression

When peripheral circulation is sluggish, morphine administered subcutaneously or intramuscularly may be absorbed slowly or not at all. Failing to obtain the expected result, the physician may make the mistake of repeating the dosage perhaps even several times. A dangerous situation may then develop when with improvement in circulation, rapid absorption of the total dose occurs leading to toxicity and perhaps even death

It is a wise policy to administer the morphine intravenously in such cases, using doses of 8 to 10 mg. (⅛ to ⅙ grain) diluted in 5 to 10 cc. of 5 per cent glucose and injected slowly over a period of 30 to 45 seconds Such doses may be repeated in 15 to 30 minutes until the desired effect is obtained i e analgesia.

The need of morphine may be minimized or eliminated by the administration of oxygen avoiding débridement and cleansing and by prompt application of petrolatum pressure dressings.

Appraisal of the Extensiveness of the Burn. Berkow's method for the estimation of surface area is most useful. The modified table of Lund and Browder gives the estimates in greater detail. The differences however are minor (Table I p 152)

The amended proportions for adults are not applicable to infants and children where there is a relative increase in head size and a decrease in the size of the lower extremities To a lesser extent, the trunk bears a similar relationship to the upper extremities

The following figures are applicable to practically all cases

Adults

Lower extremities	38 per cent
Trunk	38 per cent
Upper extremities	18 per cent
Head	6 per cent

The arms constitute three-fourths, the hand one fourth of the surface area of the upper extremity The thighs constitute one-half the legs one-third, and the feet one-sixth of the surface area of the lower extremity The anterior surface of the trunk constitutes 20 per cent and the posterior surface 18 per cent of the total trunk surface area (38 per cent) This includes the neck. The buttocks are included in the estimates for the lower extremities.

Children

Trunk	38 per cent
Upper extremities	18–19 per cent

Head and lower extremities Subtract age in years from 12 and add the difference to 6 the total equals head proportion. Subtract the same amount from 38 per cent to obtain lower extremities proportion. These will be approximate figures.

All burns should be estimated as to depth, i e first, second or third degree It is almost impossible accurately to distinguish second from third degree burns at the time of injury in many instances.

Selection of Fluids for Parenteral Use RECENT TRENDS TOWARD THE IMMEDIATE AND DELAYED USE OF WHOLE BLOOD TRANSFUSIONS It would appear from recent investigations that the most effective management of burn shock is observed when a combination of whole blood intravenously and electrolyte solution orally is used. It has been well demonstrated that immediately after a severe burn hemolysis of red blood cells occurs (as evidenced by hemoglobinemia) and that as much as 10 per cent of the remaining red cells have a fragility greater than normal and hence are susceptible to further hemolysis. It has likewise been demonstrated that minute "perithermal" hemorrhages are a frequent accompaniment of burns, thus affording a second immediate loss of whole blood. This immediate "anemia" is easily and frequently "marked" by the ensuing hemoconcentration secondary to fluid and protein loss into the burned area, so much so *that a loss as great as 40 per cent of the total red cell mass may remain undetectible immediately after the burn.* The progressive breakdown of red blood cells may continue for as long as sixty hours or even longer in some cases. Other contributory "losses" of whole blood then occur in relation to the ensuing shock. That whole blood is effective in combating burn shock has been well demonstrated, more so when electrolyte solutions are given orally to aid both in reducing hemoconcentration and supplying body needs The secondary anemia frequently seen following severe burns does not occur with this therapy

In estimating the amount of blood to be given the patient, there are no reliable standard guides available other than the fact that experimentally (and recently clinically) whole blood—2.5 to 5 per cent of the body weight—has proved effective. Somewhat larger proportions of orally administered electrolytes have been advocated. The chemical construction of these solutions is similar in nature to that of interstitial fluid, and various combinations have proved satisfactory * Reliance must be placed for the most part upon the clinical picture presented by the patient and sufficient blood is replaced to produce the desired effect.

A rough index is afforded by relating replacement volume to total surface area burned—such as the "first aid rule" often recommended in plasma replacement 500 cc. of plasma is recommended for each 10 per cent of surface area burned—to be administered in divided doses within the first 24 hours Blood being more effective than plasma, somewhat smaller replacements may be reasonably expected to produce the effects expected from larger volumes of plasma.

Such rules should be looked upon as rough guides and should not supersede sound clinical judgment.

The amount of Hartman's solution or other combinations of electrolyte is determined along similar general lines.

* Sodium chloride, sodium bicarbonate, 8 to 15 per cent of body weight. A solution containing the following has also been reported effective liter 6.10 gm. of sodium chloride, 0 20 gm. of calcium lactate, 0.20 gm. of potassium chloride, 0.07 gm. of sodium phosphate, 0 05 gm. of magnesium chloride, 2.58 gm. of sodium bicarbonate, 2.09 gm. of dextrose in 1 liter of distilled water

Lacking reliable laboratory criteria to guide intravenous replacements, the necessary replacements are best administered by the oral route as soon as the patient is able to drink. The intestinal mucosa can be depended upon to monitor the necessary electrolyte replacements more safely and accurately than can be done by any other known method.

Various measurable factors of "blood chemistry" notoriously fail to mirror accurately the abnormalities which have taken place in the interstitial fluid compartment.

In general the negative load of interstitial fluid (which one wishes to replace) is directly proportional to the edema produced by the burn

For oral use one may give half-strength Hartman s solution (Isotonic Hartman s solution is relatively "hypertonic" in relation to intestinal mucosa, and electrolyte exchange is less effective than with the more dilute mixture.) A satisfactory mixture may be prepared by dissolving 3 gm. of sodium chloride and 1.5 gm of sodium bicarbonate in 1 liter of water This "cocktail" may be chilled to increase palatability It has been shown that there is less frequent vomiting of this mixture if it contains sodium bicarbonate rather than sodium chloride alone

Water must be made available to the kidneys in sufficient quantities to maintain a urinary output above 1 liter per diem. This may be supplied either as 5 per cent glucose in water or as drinking water Great care must be exercised in this respect.

During the acute period of shock—for an adult with burns involving, say approximately 20 per cent of his surface area—one might then begin with an intravenous administration of 1000 to 1500 cc. of whole blood, 1000 cc. of Hartman s solution and 1000 cc. of 5 per cent glucose in water during the first twenty-four hours. The oral administration of electrolyte solutions is preferable if the patient is conscious and able to drink. Subsequent administrations or even prompt modification of the initial therapy depends upon clinical response

Emphasis is placed upon treating the patient as a whole and placing reliance upon clinical response rather than fulfillment of standard rules Careful attention is paid to sensorium pulse volume and venous distention frequent examinations of the lung fields are made

One of the most important features frequently overlooked in burn therapy is the fact that the numerous solutions which have been infused into the patient (for the control of shock, infection restoration of plasma volume and so forth) must ultimately be either metabolized and utilized by the patient, or excreted as "waste" products. During the period of resorption of edema (plus the products of cellular necrosis and locally applied medicaments) there must ensue a satisfactory period of excretion, else the patient remains in a state of *physicochemical imbalance* from which numerous and fatal complications may arise. The possibility of the occurrence of "water intoxication" in the so-called toxemic stage of burns may merely represent the end result of fluids introduced earlier

Local Treatment of Burned Surfaces: *General Principles of Wound Treatment* For several years after the introduction of tannic acid the problem of the local treatment of the burned surface was thought to have been solved. Unfortunately this and many other locally used medicaments served merely to keep attention from being drawn to the all-important systemic disturbances occurring in severely burned patients It is now well recognized that any attempt to become elaborate and use anything other than the simplest of coverings on an extensively burned surface will do more harm than good.

There is no absolute need to separate local treatment from the treatment of shock since they can be made to complement one another Emphasis on the priority of shock treatment or its prevention is laudable only when the local treatment is such that it is likely to aggravate or precipitate shock. In general, débridement and cleansing with their implication of morphine and/or anesthesia constitute factors conducive to production of shock in severely burned patients Moreover débridement may lead to further contamination.

In dealing with fresh burns the immediate application (under aseptic technic) of a sterile petrolatum occlusive pressure dressing has much to recommend it. This is so because a burn by the very nature of the injury is usually self-sterilizing. Infection is usually the result of contamination of the burn wound *after* the burn is received. The usual source of this contamination is the mouth and respiratory tract of the patient or attendants.

In an *adequately* treated *fresh* burn infection plays no role When it occurs, there is a proportionate rise in morbidity mortality and complications. Scar formation is further enhanced. The prevention of infection therefore is a prerequisite to good therapy

Technic

1 Standard aseptic operating room technic is used. Working in teams hastens the procedure

2 With the patient already having been afforded some protection by the application of sterile towels or sheets, and parenteral fluids having been started

(*a*) Plain petrolatum fine mesh (44 mesh) gauze strips are applied in a one-layer thickness over the entire area The petrolatum plays no specific role other than preventing adherence of dressings Place the strips in the longitudinal axis of the extremities. Avoid encircling of parts with resultant constriction if edema develops.

(*b*) Overlay the petrolatum gauze strips with several layers of "flats." The fingers and toes should be kept slightly separated.

(*c*) Follow with a generous application of sterile mechanics waste cellulocotton or "fluffs."

(*d*) Provide compression by means of an elastic ("Ace") bandage or 5 yard roll stockinet, or skin tight plaster as ad

vocated in some clinics. This dressing should provide an evenly distributed compression but should avoid restriction of circulation. In applying the dressing to an extremity care must be exercised that the dressing extends to the most distal parts to avoid a "tourniquet" effect and consequent edema of the extremity distal to the dressing.

(*e*) *Splints* (which can be made of folded newspapers) may be incorporated in the dressings for further immobilization and comfort. Elevation of the affected parts will further aid comfort, lessen edema, and minimize spread of infection.

(*f*) Once applied, this dressing is left strictly alone until the tenth to fourteenth day, unless the patient's systemic reaction raises the possibility of serious infection. If such is the case, the dressing is inspected in the areas of tenderness.

The importance of restricting the frequency of dressings has been adequately confirmed. There is a direct relationship between the rate of healing and the number of times dressings are removed. There is also a factor of increased contamination which is cumulative with each dressing change.

Chemotherapy. If the patient is seen early and a sterile dressing applied promptly, chemotherapy is unnecessary in any form.

Local application of drugs, such as the sulfonamides, not only creates the possibility for the absorption of toxic amounts of the drug, but, in addition, may unnecessarily delay healing.

Most chemotherapeutic agents are likely to destroy remaining islands of viable epithelium. The sulfonamides, in addition, may aggravate or initiate renal damage—the urinary output of fluids in these patients being minimal.

When contamination has been great enough, or treatment delayed long enough to make the likelihood of infection certain, or when infection is already present, chemotherapy is, of course, helpful. Even so, one need not depend on topical application, since orally or intravenously administered sulfonamides are rapidly made available to the burned surface. This is demonstrated by the high levels of the drug found in bleb fluid and exudate.

Locally, saline dressings will facilitate drainage, or saline baths may be used. When these are not feasible, petrolatum dressings and mechanics' waste will permit drainage of the exudate.

Débridement and Cleansing. Extensive débridement and cleansing materially shorten the survival time of experimental animals.

It has been definitely proved that débridement and cleansing are *not essential* to good burn treatment.

Though these principles generally apply, contamination is occasionally so overwhelming that the progress of infection may be minimized by some form of cleansing. *In some instances,* gentle irrigation with saline alone may do much to convert a grossly contaminated wound into a clean wound. Others may require gentle cleansing with a neutral soap

on moist cotton pledgets. In any case, the blisters are not opened since it has been demonstrated repeatedly that bleb fluid remains relatively sterile for several days. *Furthermore there is no better dressing known for burns than skin itself!*

The point to be emphasized is that one merely hopes to convert a grossly contaminated wound into a relatively clean one and not to sterilize the surface There will always be borderline cases where only sound surgical judgment can be relied upon to decide what is helpful and what is meddlesome.

All contaminated or infected wounds should be cultured.

Tetanus and Gas Gangrene Prophylaxis Tetanus antitoxin is generally indicated in most large burns For military personnel, a "booster" dose of the toxoid is all that is required. Civilians should receive a prophylactic dose of tetanus antitoxin after skin testing for serum sensitivity

When there are serious pulmonary lesions, caution must be exercised in administering any form of serum therapy which may occasionally be wisely omitted to avoid the risk of bronchospasm

Prophylaxis against gas gangrene is less clearly defined When it is indicated only reliable polyvalent preparations should be used. Even the use of these is open to serious question, since there is considerable doubt of any value obtained.

Management of Burns of the Eye Burns of the outer lids are handled exactly the same as those involving the rest of the face Windows must be provided if an occlusive dressing is used on the face to permit daily inspection of the eyes.

Local treatment of conjunctival burns consists in instillation of an ophthalmic ointment containing 2 per cent butyn sulfate and metaphan (1 3000)

Cocaine should not be instilled into burned eyes, since it produces corneal edema.

If the lid conjunctiva and eyeball have been burned the raw surfaces must be kept from uniting by passing a smooth glass probe between them daily to break up any adhesive bands tending to form, until the surfaces have healed separately

Severe cases will require grafting. Neglect will lead to symblepharon formation.

Another complication that must be watched for is *iritis* which not infrequently complicates eye burns. (Treatment consists in instillation of atropine, application of heat, and foreign protein therapy)

An ophthalmologist should be consulted in all doubtful cases.

Management of Genitorectal Burns The anatomical structure of this region and the nature of the secretions encountered, necessitates frequent tubbings or saline dressings in this area. When tubbing is feasible, a physiological concentration of fluid may be prepared by the addition of 2 pounds of ordinary table salt to a tub of water Another method in vogue is to use 1 gallon of a saturated solution of sodium chloride

to 32 gallons of water The temperature must be carefully controlled and maintained at a level of 100° to 105 F

When the patient is necessarily confined to bed, physiological saline dressings and frequent irrigations are used. Occasionally slightly hyper tonic saline is useful

Between tubbings or irrigations the patient may be placed on large absorbent pads covered with several layers of petrolatum gauze These are changed as frequently as is deemed necessary

Careful cleansing after each bowel movement is important. In chil dren it is occasionally advisable to prevent bowel movements for the first four or five days by the administration of paregoric.

Management of Burns Complicated by Fractures When a patient who is burned simultaneously sustains a fracture the treatment of both conditions is frequently made more difficult. Such patients may be classified into three groups

1 The burns and the fracture in the same location
2 The burn and the fracture in separate locations
3 A compound fracture present in the same area as the burn or in a separate area

In most cases the local treatment of the burn and the fracture can be carried out simultaneously just as though one or the other were not present. Sterile dressings are applied in the usual manner before moving the patient, similar simple dressings being applied over any compounded area.

In the first group (burn and fracture in the same location) plaster encasement has proved satisfactory in the reported cases This type of encasement, just as in dressings of burned patients, is changed every second week until the burn is healed or deemed satisfactory for grafting.

In the second group (burns and fracture in separate locations) the fracture is treated just as if no burn were present elsewhere and the burn is treated in the usual fashion Only the simplest methods of fixa tion should be used, inasmuch as grafting procedures which may be carried out later necessitate available donor sites which should be un encumbered with plaster

In the third group (burns plus compound fracture) treatment is carried out as outlined for group 1 i.e plaster encasement after suit able débridement and reduction of the compound fracture It has also been found that pins for skeletal traction may be passed through burned areas after careful local débridement and cleansing without incurring too great a risk.

Fractures in special locations will of course need special attention (hanging cast over a pressure dressing in fractures of the humerus associated with burns, skeletal traction in fractures of the femur and so forth)

General Care of the Burned Patient. Every effort must be directed toward preventing development of any factor promoting chronicity of the reparative processes. Malnutrition is one of these factors.

Nutritional Status The nutritional status of the patient must be zealously maintained remembering, of course that food offered to the patient is of no value unless it is eaten *The protein intake in severely burned patients should never be less than 100 to 125 gm. daily* Even on this intake a negative nitrogen balance may develop *

Clinical and experimental evidence has demonstrated that in burns as much as 45 gm. of nitrogen may be excreted in twenty-four hours, equivalent to the catabolism of 280 gm. of protein, or in quantity to eight transfusions of 500 cc. lots of plasma.

Large quantities of protein therefore, are indicated in the diet, and must, of necessity frequently be supplemented with commercial amino acid preparations and blood transfusions

An adequate *carbohydrate intake* is also important, not only from the standpoint of calories, but also for the protein sparing effect and avoidance of ketosis. If carbohydrate is not given in adequate quantities, protein will be broken down to provide carbohydrate for the body Given adequate carbohydrate and protein a well-nourished patient will obtain any deficit in calories from his own fat depots. If the patient is undernourished or chronically ill fat stores are no longer available and the matter of caloric intake becomes of utmost importance

The ideal method of feeding the patient is, of course, by the oral route. Supplementary feedings will be found to be almost a necessity in most cases.

Vitamin supplements are helpful, particularly A C, D and the B complex. Brewers yeast (15 gm. three times a day) is an effective and relatively cheap source for the B complex if the patient can tolerate it.

Iron supplements are necessary in the rebuilding of the hemoglobin molecule, anemia being a counterpart of all severe burns. If protein is needed both for the rebuilding of tissue and plasma proteins, and also for hemoglobin, the protein flow favors reconstruction of hemoglobin first.

It is advisable to weigh the patient on admission and at frequent intervals, the weight being used as one index of the nutritional state.

Renal Status A careful record must be kept of the patient s daily in take and output. The output, if at all possible should be maintained at 1 to 2 liters daily

Prolonged lowering of blood pressure anoxia, and precipitation of abnormal crystals (hemoglobin and sulfa drugs) are likely to cause serious renal damage (functional and organic) which may be the deciding factor in the outcome of the patient.

Electrolytes exert a significant influence on renal output.

If the amount of waste products to be excreted increases, a proportionate increase in urine water must be available to hold these waste products in solution. If primary renal disease is present, concentrating ability is impaired and larger quantities of water must be made available Hartman s solution or the "cocktail" referred to previously tends

* Nitrogen balance occurs when the nitrogen of the diet equals the nitrogen of the urine plus the small loss in the feces.

to improve renal output. Under ordinary circumstances, 5 per cent glucose in water will supply sufficient "available" fluid to promote urinary flow

Daily urinalysis, with particular attention to specific gravity, reaction and microscopic examination of the sediment, is useful in controlling this phase of the treatment.

Hemoglobinemia and *hemoglobinuria* occur frequently in the early phases of severe burns. The precipitation of hemoglobin crystals in the renal tubules under these circumstances is, therefore, not entirely unexpected particularly if acidosis is present. Observation of the total urinary output and sediment may lead one to suspect this difficulty and introduce appropriate therapy

Many burned patients pass into a state of severe oliguria or anuria from which they may not recover The exact mechanisms at fault are not too clearly understood at present.

Liver Function In patients with severe burns, who are treated with applications of tannic acid locally the incidence of liver damage will be high and correspondingly serious.

Anoxia likewise is capable of producing liver damage, particularly in those cases in which severe hypotension or shock has been present for a prolonged period of time

It is well established that a high carbohydrate, high protein intake offers an excellent protective influence in liver function

Factors of the vitamin B complex, particularly thiamine, are required for normal carbohydrate metabolism The liver plays an important role in this metabolism. Since the B complex is rapidly dissipated (and probably liver stored) supplements of vitamin B complex may prove helpful in the over-all general care of the patient.

Gastro-Intestinal Damage ULCERATION AND HEMORRHAGE. It has been estimated that 3 3 to 3.8 per cent of patients dying from severe burns demonstrate the presence of a Curling's ulcer of the stomach or duodenum The incidence is highest in the younger age groups (up to ten years) although this may be due to the fact that a larger number of children are burned in contrast to adults.

Occasionally these ulcers may go on to perforation.

Intestinal ulceration and bleeding are not infrequently encountered in extensively burned patients, and may contribute significantly to the development of shock and anemia.

An elevated nonprotein nitrogen may be associated with massive intestinal bleeding, and may be the clue to its presence if renal function is satisfactory

Repeated stool examinations for blood should, therefore be done on all seriously burned patients.

VOMITING This may be due to a delayed emptying of the stomach which is frequently associated with an inadequate or lowered total blood volume If this is so, it should be relieved by adequate whole blood replacement.

The composition and quantity of the electrolyte fluids being replaced

may be at fault. Underhill has reported frequent relief of vomiting in patients receiving isotonic saline following the administration of 5 to 10 gm of sodium bicarbonate by mouth.

Rapid administration of fluids is occasionally responsible for vomiting particularly when given by continuous drip through a Levin tube.

Occasionally morphine alone is responsible suggesting an alteration in dosage or a change to some other drug.

Summary of Frequently Used Laboratory Data At some time in the course of treatment of a severe burn, practically all the following laboratory examinations will be found desirable if a careful study is being made of the case Nearly all the determinations based on an examination of blood can be seriously misleading, unless the clinician is acutely aware of the readjustments which have taken place in total blood volume and the other fluid compartments of the body since the burn. Repeated examinations will therefore be of much more value than a single determination

1 Red blood count
2. White blood count
3 Hematocrit
4 Hemoglobin
5 Total serum proteins (fractionation)
6 Plasma chlorides
7 Carbon dioxide-combining power
8 Nonprotein nitrogen
9 Prothrombin time
10 Bilirubin
11 Sulfonamide levels
12. Urinalysis with micro-examination repeated
13 Bacteriologic studies
14 Stool examinations
15 Chest x-ray
16 Nitrogen balance studies
17 Vital capacity
18 CO content of blood
19 Liver function studies
20. Plasma hemoglobin

It is practically impossible to state the prognosis of a severe burn from any single laboratory examination. In general repeated hematocrit, plasma proteins, nonprotein nitrogen and carbon dioxide determinations are the most helpful in supplementing clinical judgment

Emotional Aspect of General Care Extensively burned patients frequently present problems in emotional adjustment involving such factors as disfigurement, disability and economic loss. Occasionally well-developed psychoses may appear and require careful treatment by a competent psychiatrist.

The physician must also be aware of the production of permanent nerve cell damage to the basal ganglia and cortex as a result of severe anoxia. Such changes lead to the development of athetoid chorea aphasias, and so forth The sudden death seen in certain patients undergoing treatment for extensive burns has been attributed to this factor

Experience has demonstrated that *occupational therapy* is beneficial to burn patients from both a mental and physical standpoint. It is a factor in the emotional care of the patient which must not be disregarded especially in chronic cases.

Principles of Skin Grafting: *Local Medicaments and Chemical Débridement* The claimants for various preparations alleged to insure complete healing without scarring apparently fail to appreciate the mechan

um of healing. No preparation is known that will "grow" normal skin or cause cellular repair to proceed any faster than normally obtained under optimal nutritional conditions and in the absence of infection or toxic topical agents.

Skin grafting of these areas is therefore to be carried out at the earliest optimal moment. If the skin is replaced satisfactorily surface losses, infection anemia and other difficulties disappear from the clinical picture

Under the treatment outlined previously regeneration of areas of *partial loss* should be complete within a two-week period unless complicated by infection. In any event, at the time of the first change of dressing (usually the tenth to fourteenth day) it is possible to make an appraisal of the areas requiring grafting.

To facilitate the separation of slough bloodless piecemeal excision of the edges may be used The time required for the complete separation of the slough is, of course, variable and may take from two to four weeks for the completion During this period saline dressings may be used to prepare the "soil" for grafting. (Pyruvic acid dressings maintained at the proper *p*H and thickness, have been advocated by several clinics.) The parts ready for grafting may be covered with skin while the surgeon is waiting upon separation of slough elsewhere One should bear in mind that it is *practically impossible to keep an* area of slough sterile.

If grafting is delayed for any reason, or treatment prolonged exuberant granulations are likely to occur in the wound These in turn lead to heavy subgraft scarring, interference with blood supply and a consequent reduction in the percentage of "takes." It is much better to excise exuberant granulations before proceeding with grafting, paring them down to a firm base. Skin grafts are also likely to fail in the extensively burned patient if the hemoglobin level is allowed to drop below 80 per cent.

Penicillin, administered for forty-eight to seventy-two hours *before* grafting and for several days afterwards, may decrease the incidence of infection and improve the percentage of "takes."

Autogenous and Homologous Grafts When a patient is severely burned, a full thickness loss of skin may occur (*a*) as a direct result of the burn or (*b*) as a secondary conversion from partial to full thickness loss as a result of chemical agents utilized in the treatment of the local lesion or secondary infection.

Whatever the mechanism the end result is an *open, granulating* wound. From such a surface there is a constant loss of blood *constituents* and secondary infection and septicemia remain a constant threat (see Fig. 95 p 151)

Unless early grafting is carried out, these wounds either *fail to heal* or must heal by contraction of adjacent tissues and the formation of "scar epithelium"

For the patient with extensive raw surfaces, who appears to be losing

ground despite all the known supportive measures, and, accordingly remains unsuitable for operation it may become necessary as a life saving procedure to use *homografts* Several donors may be recruited from the patient s family each contributing a sheet of split-thickness skin. These may then be applied to the raw surfaces of the patient with out anesthesia and retained in place with pressure dressings. Homografts thus applied may survive three to ten weeks, affording the patient sur cease from painful dressings, eliminating the debilitating loss of blood

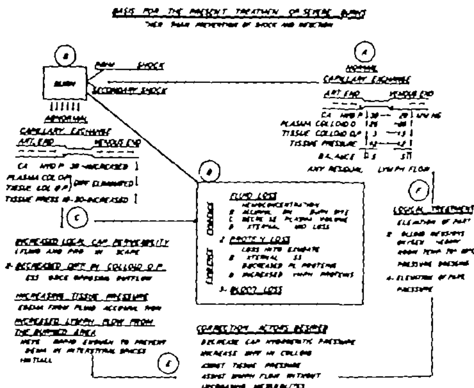


Fig. 94 A graphic representation of the altered physiological mechanisms occurring in association with burns, excluding shock and infection. The role of whole blood transfusions in the treatment recommended to restore these mechanisms to normal has been omitted for the sake of clarity

constituents from the uncovered surfaces, and permitting general improvement. Coincident with this improvement there will be a stabilization of the serum proteins and maintenance of a satisfactory level of hemoglobin. Piecemeal replacements with the patient's own skin may then be carried out.

The advantages of operating in teams upon burn patients to minimize blood loss and reduce the period of anesthesia is obvious.

The importance of early skin grafting cannot be overemphasized.

Contractures and Deformities. Contractures and deformities are the end result of a long-continued granulating surface and will continue

is inversely proportional to the height of the capillary above the heart. To increase the difference in colloid osmotic pressures so that a greater force will oppose escape of fluid, two forms of treatment are instituted More colloid is infused (plasma, blood and oxygen are given) to ameliorate any existing anoxia and thus allow capillary permeability to return to a more normal state The temperature control likewise influences this latter mechanism To assist tissue pressure and thus oppose outward flow a pressure dressing is applied To assist lymph flow (and lessen edema of interstitial spaces) without increasing metabolites the part is immobilized and elevated and a pressure dressing is applied.

The role played by whole blood transfusions has been purposely omitted from the graph for clarity They would, of course be used under the section termed "colloid infusions." Under (*D*) red blood cells should be included along with fluid and protein losses.

This brief outline of the present policies of treatment of the severely burned patient will undoubtedly undergo frequent revisions as time and experience dictate By necessity a large number of important publications on burns were purposely not quoted or included in the text. The bibliography was compiled with the purpose in mind of reflecting recent trends in therapy and their background, and a more complete one can be found elsewhere

SHOCK*

Its Nature and Origins

Clinically the term "shock" is used to denote a condition of circulatory deficiency indicated by weakness *prostration tachycardia feeble* pulse, pallor apathy or unconsciousness and diminished blood pressure. However these signs indicate not a disease entity but a syndrome they may result from various conditions having no other features in common syncope fright, exhaustion anesthesia, drugs, hemorrhage primary shock cardiac failure or secondary shock Each of these, and other conditions, may cause low blood pressure hence they cannot be differentiated *by that criterion.*

Shock from trauma or extensive surgical procedures may result from at least three mechanisms which may operate singly or in combination

1 *Primary* or *neurogenic shock* is a neurovascular reaction like that of syncope or fainting. It may be excited by pain, fear, and the emotional effects of the injury or perhaps by nonsensory nerve impulses arising in damaged tissues Primary shock comes on promptly and is usually transient unless accompanied by extensive trauma or hemorrhage then it may continue and merge gradually into secondary shock without an interval of partial recovery

2. *Hemorrhage* is an obvious cause for circulatory deficiency following injuries. This may develop suddenly from voluminous loss of blood or gradually after slow or repeated small hemorrhages Low blood pres-

*By Virgil H Moon, M.D

long before grafting. Prolonged invalidism and disability represent added expenditure with lessened earning power

Altered Physiologic Mechanisms Associated with Burns (Fig. 94) A physiological interpretation of the basis for the present treatment of severe burns In (*A*) a theoretical balance obtains between the forces enhancing escape of fluid through the endothelial lining of the capillary (capillary hydrostatic pressure and tissue colloid osmotic pressure) and forces opposing the escape of this fluid (plasma colloid osmotic pressure and tissue pressure) The figures cited are approximate Any temporary imbalance (muscular exercise and so forth) would theoretically result in an increased lymph flow with reestablishment of balance After a severe burn (*B*) abnormal capillary exchange develops with the sequence of events illustrated in (*C*) and the resultant fluid and protein loss cited in (*D*) The evidence for such losses is given. The factors resultant from or associated with the sequence of events given under (*C*) which can be corrected clinically are listed under (*E*) The establishment of these correction factors (*E*) gives rise to the "logical" present treatment of severe burns (*F*) other than the prevention of shock and infection. To decrease capillary hydrostatic pressure, the part is elevated, inasmuch as capillary hydrostatic pressure

TABLE I *Appraisal of Extensiveness of Burns*
Percentage of Surface Area (Berkow)

Age	Head	Trunk*	Upper Extremities	Lower Extremities†
0	18	38	18	26
1	17	38	18	27
5	13	38	18	31
10	8	38	18	36
15	6	38	18	38
Adult	6	38	18	38

Modified Table (Lund-Browder)

Age	Head	Trunk‡	Upper Extremities	Lower Extremities
0	19	34	19	28
1	17	34	19	30
5	13	34	19	34
10	11	34	19	36
15	9	34	19	38
Adult	7	34	19	40

* Includes neck and genitalia.
† Includes buttocks.
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is inversely proportional to the height of the capillary above the heart. To increase the difference in colloid osmotic pressures, so that a greater force will oppose escape of fluid two forms of treatment are instituted More colloid is infused (plasma blood and oxygen are given) to ameliorate any existing anoxia and thus allow capillary permeability to return to a more normal state. The temperature control likewise influences this latter mechanism To assist tissue pressure and thus oppose outward flow a pressure dressing is applied To assist lymph flow (and lessen edema of interstitial spaces) without increasing metabolites, the part is immobilized and elevated and a pressure dressing is applied.

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sure developing shortly after trauma is due chiefly to neurogenic and hemorrhagic effects.

3 *Secondary shock* is due largely to atony and abnormal permeability of capillary endothelium. Products of tissue autolysis or of infection, absorbed from damaged tissues affect the endothelium as do histamine peptone toxins and other capillary poisons. This effect, produced in extensive areas, deranges fluid balance. When capillary endothelium becomes so permeable that plasma colloids leak through it, osmotic processes cease, fluid balance is upset, and edema and a tendency to hemoconcentration result.

Dilatation of capillaries and venules increases the volume capacity of the vascular system leakage of fluid from the blood into the tissues lowers the blood volume The combination of these factors creates a disparity between the blood volume and the volume capacity of the stream bed. The resulting circulatory deficiency produces clinical signs like those of primary shock or the effects of hemorrhage. But the mechanism of capillary damage requires tissue for development it is never present immediately after injury hence it is called *delayed* or *secondary* shock.

Circulatory deficiency following trauma may be due to neurovascular reactions or to the effects of hemorrhage or the absorption of toxin products, or it may be due in part to each. These factors vary in different cases and in the same case at different times.

The view that surgical and traumatic shock are due entirely to hemorrhage and local loss of fluid was modified by subsequent investigators. Several working independently found that exchange transfusions of blood between shocked and normal dogs caused evidence of shock in the latter Others produced shock by trauma by tourniquet and by freezing, in dogs whose limbs had been taped to prevent excessive loss of blood and fluid in the injured areas They concluded that local loss of blood and fluid was not sufficient to explain the resulting circulatory failure Other workers found that lymph collected from traumatized areas produced shock when given intravenously to normal dogs. In some instances bacterial products in this lymph were believed to be a factor (All battle wounds and accidental injuries are grossly contaminated, and bacterial growth proceeds rapidly in crushed, devitalized tissues.) One group of workers showed that blood from areas of injury or anoxia contained a vasodepressor substance which caused dilatation of capillaries and venules in the viscera.

Summarizing the problems of shock, Blalock found general agreement that traumatic shock is due to regional loss of blood, toxemia or nerve impulses, separately or in combination He stated that the search for and the identification of the toxic substance or substances is the problem of first importance Few will disagree with his previous statement that surgical shock has not one, but many causes the anesthetic, the local loss of blood and fluid, anoxemia, emotional influences such as fear or pain, vascular reflexes, loss of fluid by vomiting or otherwise,

infection intoxication and the debilitating effects of the disease which made operative procedures necessary The relative importance of these factors varies in each case and they operate in varying combinations in different cases

I have attempted to show diagramatically the relationship of the various factors in the dynamics of shock It is significant that this mechanism has a self-perpetuating quality which causes it to operate in a vicious cycle, and thus leads to an irreversible stage.

Practical Management

The best treatment for shock is prevention (Crile)

The surgeon s concern is to forestall the development of shock resulting from operative procedures or injuries If familiar with the mechanism and with the various factors which contribute to it, he is prepared to do this effectively When considering the hazards of a contemplated operation, the functional capacity of the heart, the kidneys and other organs is taken into account. Experience and a high quality of judgment are required to estimate the operative risk, and the general state of health of the patient. This risk may be lowered by a period of bed rest, attention to nutrition, and the elimination of infection anemia or other deleterious factors. Extensive surgical procedures should not be undertaken when the plasma proteins are lower than 6 per cent. Hypoproteinemia may be counteracted by giving concentrated plasma, casein hydrolysates or amino acids intravenously A transfusion of whole blood is an excellent preoperative precaution

Anesthesia. The contributory effects of general anesthesia are indisputable. Though not sufficient to cause circulatory disturbances in a normal healthy person they often leave a narrow margin of safety and may precipitate shock when combined with operative procedures, loss of blood, infection, inefficient cardiac or renal function Bourne noted that general anesthesia tends to disturb fluid balance, to lower the alkaline reserve, to decrease the *p*H and to diminish the volume of urine excreted. He favored regional, i e spinal or local anesthesia whenever possible and nitrous oxide plus oxygen for general anesthesia Several writers state that this contributes less to shock than do other forms of general anesthesia. Nitrous oxide alone is dangerous when shock is feared, because it tends to produce anoxia. Bourne found that the various compounds of barbituric acid likewise contribute dangerously to anoxia. Regardless of what anesthetic agent is used its contributory effects will be proportional to the amount used and to the duration These will be minimized by reducing the duration of the operation to the shortest possible time consistent with careful and effective technic

Experienced surgeons avoid every form of unnecessary trauma to the tissues. They use sharp instruments because these cause less damage they avoid the unnecessary use of clamps and hemostats. When ligatures are applied, they remember that all tissues distal to the ligature must die from lack of blood. Absorption from these necrotic areas will

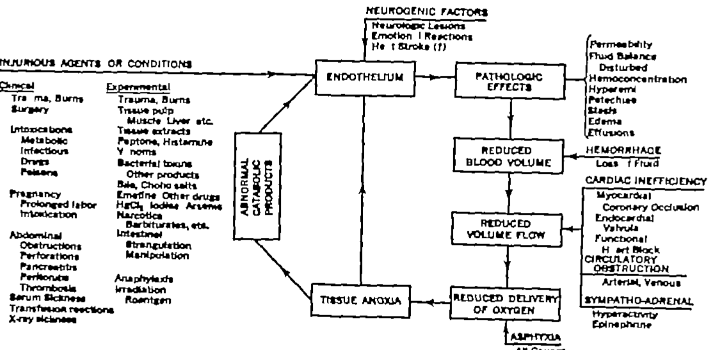


Fig. 96 Diagram showing how various factors contribute to shock, and some of the conditions in which it may occur Harkins mentioned some thirty such conditions. It also illustrates a vicious circle which leads to irreversibility (V H. Moon Shock, Its Dynamics, Occurrence and Management. Philadelphia, Lea and Febiger)

be added to the effects of other factors All manipulation of viscera and of exposed tissues is done gently and not unnecessarily Sponging and rubbing of all tissues are reduced to the minimum

No item in the prevention of shock is more important than the prevention of hemorrhage. A moderate loss of blood occurring coincidental with disease, anesthesia, severe trauma or surgery may produce serious or fatal results. A person in whom shock is imminent or is already developing cannot withstand a small loss of blood which to a healthy person would be of no consequence. Loss of fluid into the tissues or by vomiting, purging or perspiration contributes dangerously to circulatory failure if shock is developing. When the mechanism of fluid balance is deranged, such loss of fluid is not readily compensated The importance of any loss of blood or fluid is proportionate to the volume lost.

Anoxia develops more readily in subjects whose red cells and hemoglobin are below normal. The operative risk is reduced by giving transfusions of whole blood before surgical procedures The volume of blood which may prevent shock is much smaller than that required to combat circulatory deficiency after it has developed In some clinics infusions of saline or of glucose-saline solution are given to increase the volume of body fluids before surgical procedures. The inhalation of oxygen as practiced in many clinics is a logical means for preventing or counteracting anoxemia.

Therapy Efforts to counteract shock and to restore circulatory efficiency by the use of drugs have been uniformly unsuccessful The use of morphine for relief of pain is sanctioned, but, beyond the minimum necessary for this purpose, is dangerous. It lowers respiration seriously thereby contributing to anoxia and accelerating the development of shock Such stimulants as digitalis and adrenalin are useless Cardiac deficiency is not a factor in the development of shock excepting from organic cardiac disease The decreased volume output of the heart results from a decreased return flow of blood from systemic areas. When finally the heart action weakens, it is largely due to anoxia and to toxic effects. No known drug will counteract these conditions or relieve the stasis of blood in the visceral areas When shock develops, the peripheral arteries are maximally contracted hence benefit from adrenalin cannot be expected furthermore, large or repeated doses of it will actually cause shock.

Adrenal cortical extract has the physiologic property of maintaining normal impermeability of endothelium Hence it was hoped that this would be a valuable agent in the treatment of shock Clinical trial has shown that cortical extract is probably of value in preventing shock after injuries or extensive operative procedures. Its use after shock has developed has not been found to produce benefit.

Attempts formerly were made to raise the body temperature by the application of heat. Reduced blood volume either by secondary shock or by hemorrhage, results in a redistribution of blood favoring vital organs at the expense of the periphery There the vascular channels become collapsed and relatively bloodless, but circulation is maintained

where it is most needed. The reduced temperature of external parts results from their reduced circulation, but rectal temperatures are usually normal. This indicates that the visceral circulation has been maintained. To open up the peripheral vascular bed by heat and rubbing counteracts nature's mechanism for conservation. The blood required to fill these vessels lowers needlessly the already depleted blood volume. Recent evidence both experimental and clinical indicates that the application of *heat does not counteract shock* and that the results are not beneficial.

The successful management of shock requires first, that the causative condition be removed. If shock has resulted from a mangled limb, an intestinal obstruction or from an infected area, no therapeutic measures will be effective until amputation of the limb release of the obstruction or drainage of the infected area has been accomplished. Next, the fluid lost from the blood must be replaced. After hemorrhages or when the subject is anemic, transfusions of whole blood provide the ideal remedy These should be given so long as the hematocrit reading is below 45 or the erythrocytes below 4,500 000 But when shock is accompanied by hemoconcentration as after burns, whole blood is not suitable the patient does not lack erythrocytes, but he sorely needs fluid to restore both the normal composition and the volume of blood Then the ideal replacement fluid is either human plasma or serum.

These agents, given in the normal or isotonic concentration, serve adequately to restore the blood volume But the same amount of plasma given in twice to four times its normal concentration raises the osmotic pressure of the blood and thereby counteracts the edema by drawing fluid from the tissues into the vascular system. This restores the blood volume in part by returning to the blood the same kind of fluid which it had lost. The amounts required, either of whole blood or plasma, cannot be specified or estimated accurately an adequate amount in one case may be far below what is required by another Enough must be given and repeated, to raise the blood pressure to a physiologic level and to maintain circulatory efficiency Harkins advised giving 100 cc. of plasma for each point the hematocrit reading is above 45 Slow continuous introduction is recommended.

Early recognition and treatment are highly important. Moderate amounts given early will accomplish more than large quantities a few hours later Treatment, to be effective must anticipate the interplay of the factors whose combined effects culminate in the syndrome of secondary shock Treatment must be instituted before the lagging circulation and the associated anoxia have produced irreversible changes in tissues whose functions are vital.

INFECTIONS OF MOUTH AND NECK

Landmarks.

1 The angle of the jaw marks the lower limit of the pharyngomaxillary space

2. The junction of the submental area and the vertical plane of the neck locates the hyoid bone
3 The upper margin of the thyroid cartilage is the point of bifurcation of the carotid artery It is at the level of the fourth cervical vertebra.
4 The cricoid cartilage locates the sixth cervical vertebra and the beginning of the esophagus. This is important in peri-esophageal abscess.
5 The suprasternal fossa (Burns space) is easily recognized
6 The midpoint of the sternocleidomastoid muscle between the mastoid process and the sternal attachment marks the emergence of the cervical nerves along the posterior border of the muscle

Cervical Fascia. Viewed from a surgical standpoint, the cervical fascia creates compartments with consequent intervening spaces as the result of enclosing groups of muscles, vessels, nerves and glands Extension of pus is limited laterally by these fascial envelopes but pus travels readily downward and upward along the fascia, the muscles and the vessels.

The neck can be visualized as a cylindrical compartment bounded by the superficial layer of the deep cervical fascia and including smaller fascial enclosed compartments containing viscera, vessels and nerves and such other structures as the carotid sheath, a visceral compartment containing the larynx trachea and esophagus, and the large compartment posterior to the prevertebral fascia

Submaxillary Space; Floor of Mouth; Tongue The mylohyoid muscle is the important structure influencing the location and travel of pus The plane of this muscle floor slants downward and forward Fluid tends to gravitate toward the chin. The posterior limit of this muscle is the plane of the third molar tooth Pus can flow over this posterior edge into the neck. The *submaxillary gland lies below* and its duct (Wharton s) above, this muscle. The *sublingual gland lies above* this muscle and immediately above the submaxillary gland.

The fascia of the submaxillary space comes from the covering of the hyoid bone It splits to invest the gland The mesial layer covers the inferior surface of the mylohyoid muscle, and the outer layer attaches to the lower edge of the mandible

The lymphatic structures drain into the submental submaxillary pharyngeal and deep cervical channels. Infection in the submaxillary fossa may be parenchymatous (glandular) or periglandular The clinical differentiation depends on the presence of pus in Wharton s duct. Drainage by this channel may be adequate in the glandular type of suppuration.

Ludwig's Angina To mention this type of purulent inflammation seems relevant here The *symptoms and signs* of the condition are as follows

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6 The midpoint of the sternocleidomastoid muscle between the mastoid process and the sternal attachment marks the emergence of the cervical nerves along the posterior border of the muscle.

Cervical Fascia. Viewed from a surgical standpoint, the cervical fascia creates compartments with consequent intervening spaces as the result of enclosing groups of muscles, vessels, nerves and glands Extension of pus is limited laterally by these fascial envelopes but pus travels readily downward and upward along the fascia, the muscles and the vessels.

The neck can be visualized as a cylindrical compartment bounded by the superficial layer of the deep cervical fascia and including smaller fascial enclosed compartments containing viscera vessels and nerves and such other structures as the carotid sheath a visceral compartment containing the larynx, trachea and esophagus, and the large compartment posterior to the prevertebral fascia

Submaxillary Space; Floor of Mouth; Tongue. The mylohyoid muscle is the important structure influencing the location and travel of pus The plane of this muscle floor slants downward and forward Fluid tends to gravitate toward the chin The posterior limit of this muscle is the plane of the third molar tooth Pus can flow over this posterior edge into the neck. The *submaxillary gland lies below* and its duct (Wharton s) above, this muscle The *sublingual gland lies above* this muscle and immediately above the submaxillary gland.

The fascia of the submaxillary space comes from the covering of the hyoid bone It splits to invest the gland The mesial layer covers the inferior surface of the mylohyoid muscle, and the outer layer attaches to the lower edge of the mandible

The lymphatic structures drain into the submental submaxillary pharyngeal and deep cervical channels. Infection in the submaxillary fossa may be parenchymatous (glandular) or periglandular The clinical differentiation depends on the presence of pus in Wharton s duct. Drainage by this channel may be adequate in the glandular type of suppuration.

Ludwig s Angina To mention this type of purulent inflammation seems relevant here The *symptoms and signs* of the condition are as follows

1 Acute illness with chill and rise in temperature
2. Pain in the floor of the mouth and in the tongue

3 Painful swallowing and respiration
4 Tenderness on palpation
5 Cellulitis in the floor of the mouth and under the chin
6 Swelling with marked displacement of the tongue

Abscess of Base of Tongue This is another relevant type of purulent inflammation. Its *symptoms and signs* follow

1 Pain and restricted motion
2. Dysphagia
3 Difficulty in respiration which rapidly increases because of edema of the epiglottis and laryngeal structures

Surgical Drainage The submaxillary space is drained by incision of the skin superficial fascia, platysma muscle and deep cervical fascia. The incision is placed above the superior border of the digastric muscle and may extend from the chin to the angle of the jaw depending on the extent of involvement (Fig. 97 *1*) When the gland itself is involved, the capsule of the gland is incised.

Superficial purulent collections in the floor of the mouth may be drained intra-orally A deep collection of pus anteriorly and medially both above and below the muscle is best approached through a curvilinear incision below the chin The mylohyoid muscle is divided vertically along the raphe for drainage of deep lingual infection This cutaneous incision precludes an elevated scar band after healing.

Tracheotomy should be considered early in cases in which the tongue is involved.

Pharyngomaxillary Space (Parapharyngeal Space) This potential space exists only when it is occupied by fluid. The anterior compartment is the real pharyngomaxillary space and the posterior compartment is an extension of the carotid sheath

Anterior Compartment This extends from the base of the skull downward to the level of the angle of the jaw Its boundaries are as follows

ANTEROMEDIAL WALL. Buccopharyngeal fascia and anterior pharyngeal wall.

ANTEROLATERAL WALL. Fascia of internal pterygoid muscle

POSTEROLATERAL WALL. Fascia of parotid gland in its lower portion (it is absent above) fascia of the styloid process and its muscles and part of anterior wall of carotid sheath

POSTEROMEDIAL WALL. Alar fascia.

Posterior Compartment This is a separate anatomic entity (carotid sheath) It is closely related clinically and pathologically to the anterior compartment. Pus may find its way into the neck by following the anterior wall of the sheath and may involve its vascular content (jugular thrombosis)

Retropharyngeal Spaces. The pharynx extends from the inferior surface of the sphenoid bone to the beginning of the esophagus (sixth cervical vertebra) The wall of the pharynx, composed of mucous membrane aponeurosis constrictor muscles and buccopharyngeal fascia,

constitutes the anterior wall of the retropharyngeal space This fascia is derived from the prevertebral fascia The posterior wall is composed of the prevertebral fascia and muscles Loose areolar tissue between the two layers of fascia permits movement of the pharynx. The inferior continuation of the prevertebral fascia extends to the posterior mediastinum

The prevertebral muscles are determining factors in the direction of extension and localization of collections of pus. The longus colli muscles extend upward and downward in the midline (retropharyngeal) The

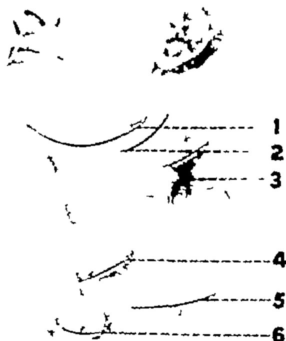


Fig. 97 Lines of incision for drainage 1 Submaxillary gland and space 2 pharyngomaxillary space 3 lateral pharyngeal space 4 peri-esophageal space, anterior 5 peri-esophageal space, posterior 6 mediastinum.

longus capitis (superiorly) and the scalenus anticus muscles (inferiorly) extend downward and outward. Infections spreading laterally, follow these muscle sheaths behind the carotid sheath to the posterior border of the sternocleidomastoid muscle

Surgical Drainage of Retropharyngeal Abscess Place the patient in the Trendelenburg position Incise through the pharyngeal wall Apply suction if it is available

Lateral Pharyngeal Space. This space is actually that part of the retropharyngeal space which extends beyond the lateral limits of the pharynx. The alar fascia determines the existence of this space It is an extension connecting the visceral fascia of the pharynx and the carotid sheath The *upper part* of this space extends from the base of the skull down-

ward to the level of the angle of the jaw Its lateral boundaries are the carotid fascia and the pharyngomaxillary space its posterior boundary the prevertebral fascia, and its anterior boundary the buccopharyngeal aponeurosis. The *inferior part* of this space ends at the beginning of the esophagus (sixth cervical vertebra cricoid cartilage) Its anterior and *posterior boundaries are the same as above It is limited laterally* by the alar fascia and the carotid sheath

Infection in the retropharyngeal space extends either upward or downward in its early course and manifests itself *in the neck* (laterally) *late* in its history Infection in the lateral space manifests itself *in the neck early* in its progress and extends laterally Such infections travel behind the carotid sheath in the direction of the posterior border of the sternocleidomastoid muscle

Surgical Drainage of Lateral Pharyngeal Abscess In an *early stage* use the intra-oral approach. Incise the mucosa and aponeurosis and then proceed with blunt separation Avoid injury to large neighboring vessels. In a *late stage* (*swelling in posterior triangle of the neck*), *incise along* the posterior border of the sternocleidomastoid muscle over the point of maximal swelling and follow the fascial cleavage backward and med*ially to the prevertebral fascia (Fig. 97) Avoid the cervical nerves* coming around the border of this muscle at its midpoint.

Peri-esophageal Space. The esophagus is surrounded by loose areolar tissue throughout its length The posterior wall of the esophagus lies on the prevertebral fascia and forms the front boundary of the preverte bral space This is a continuation of the retropharyngeal space it continues downward below the clavicles as the posterior mediastinum. The anterior wall is formed by the pretracheal fascia which extends medially from the carotid sheath It envelops the thyroid gland and passes under the depressor muscles of the hyoid bone on to the trachea to fuse with the fascia from the opposite side The lateral lobes of the thyroid gland *meet the esophagus and form part of* the lateral boundary of this space. The superior limit is the attachment of the fascia to the hyoid bone

This space contains the larynx recurrent laryngeal nerves the thyroid gland *the inferior thyroid vessels and the esophagus.*

Infection from injury to the posterior wall travels readily and rapidly into the *mediastinum* It extends laterally along the prevertebral fascia to appear behind the posterior border of the *sternocleidomastoid muscle.*

Surgical Drainage Incise along the posterior border of the sternocleidomastoid muscle down to the prevertebral fascia, and follow this plane medially with the finger until pus is located (Fig. 97 5)

Infections from Anterior Esophageal Wall and Trachea. These extend anteriorly and laterally under the thyroid gland and are limited by the carotid sheath. They manifest themselves along the anterior border of the sternocleidomastoid muscle and are best approached along this line (Fig 97 4)

Surgical Drainage Incise along the anterior border of the sternocleidomastoid muscle through the superficial layer of the deep fascia.

Separate the tissues of the space between the carotid sheath and the gland and incise the thickened pretracheal fascia. Extend bluntly (finger) If the thyroid gland is involved, its capsule must also be incised.

Cervical Mediastinotomy This may be performed on either side of the neck. The right is preferable when election of site may be made

A curvilinear incision is carried along the anterior border of the sternocleidomastoid muscle down to the clavicle, and then laterally along the clavicle (Fig. 97 6) The pleura is high in the right side of the neck, and care must be exercised to avoid it. The trachea and esophagus are exposed and separated from the prevertebral fascia. The dissection is continued along this fascia into the superior mediastinum bluntly, with the finger This dissection is directed between the big vessels with this approach. The dissection on the left side is carried lateral to the carotid artery and jugular vein

A tube is inserted and continuous suction applied with the patient in the Trendelenburg position.

WOUND HEALING

Wound healing is a physiological process depending, in general upon the laws of tissue growth. The initial presence of dead tissue cells, foreign material and bacteria determines a so-called lag period in which these cells and material are autolyzed removed by phagocytes or extruded. The amount of such damage, plus the vascularity of the local tissue bordering the wound and the virulence of infecting bacteria determines the so-called healing by primary and secondary intention

Healing by *primary intention* occurs when the edges are clean and approximated. The several processes act together There is dilatation of marginal vessels with the transudation of plasma between the edges and over the surface of the wound This changes to fibrin, which is invaded by polymorphonuclear leukocytes and histiocytes These cause a destructive stage of autolysis and phagocytosis of the foreign material At the same time capillaries, fibroblasts and fibrocytes invade the fibrin and epithelium from the wound edges completes the regeneration

Healing by *secondary intention* is occasioned by the amount of dead and damaged tissue in and about the wound. There is a transudation of plasma which forms a crust under which the destructive phase occurs proteolysis and phagocytosis

The crust separates after its base has been liquefied by proteolytic action, leaving small buds of granulation which consist of capillary loops covered with fibroblasts and phagocytes These remove the necrotic tissue and fuse to form the granulation bed. Epithelium growing from the borders any remaining islands, gland tubules, and so forth complete the regeneration.

Fresh Wounds. Emergency cases should be handled immediately in a manner that neither contributes to infection nor further reduces the vitality of damaged, bleeding tissue Bleeding should be stopped promptly by pressure with sterile gauze, clean sheeting or linen Tense

pressure dressings and tourniquets should be avoided, if possible If they are required the part should be refrigerated until the course of bleeding can be properly controlled.

All fresh wounds are contaminated to some degree This condition persists for six to twelve hours before the invasion and incubation of the included infecting organisms During this period the wound may be thoroughly cleansed and débrided and foreign material removed under strict asepsis *The hemostasis should be absolute and the tissue handled* without added trauma The lag period before active healing in these cases is approximately four days The change from this period occurs as the result of the maturation of the fibroblasts and their elongation uniting the wound Colloidogen fibers are developed by the fibroblasts, but produce no appreciable tensile strength in the wound. Fibroplasia, characterized by rapid increase in tensile strength now occurs

During this lag period of four days the surgeon depends upon sutures, relaxation devices proper pressure and splinting. Their intelligent use determines, to a large degree the final local outcome of the care.

Definitive Treatment The immediate care and later management of shock are fundamental This is discussed elsewhere (p 153)

The wound and its surroundings are thoroughly cleansed with benzene or ether This cleansing is followed with soap and water or Parke Davis and Company detergent if grease is present The wound may be débrided within six to twelve hours Because of its blood supply the face is an exception in our experience It is thoroughly cleansed, all foreign body removed cautiously débrided Stenson's duct and motor nerves repaired, if required all fractures reduced and wired, if necessary and the soft tissue closed in staggered suture lines sulfonamides and/or antibiotics are given prophylactically The final result of such management is highly satisfactory

Wound edges are trimmed squarely in good tissue, total hemostasis is accomplished, and fine sutures all placed with proper tension. Drainage is provided as indicated. The surface is dressed with Furacin or saline-impregnated gauze

Surface wounds are closed with tissue from their borders, or immediately grafted if the loss does not permit the former

The general or systemic condition demands careful and constant attention. Correct secondary anemia and circulatory imbalance check the fluid, protein and electrolyte balance (see p 140) *Hypoproteinemia* retards fibroblastic growth. Maintain a normal nutritional balance. Give a maintenance dose of all vitamins and add therapeutic doses of C and K.

Tetanus serum or toxoid and gas gangrene antitoxin are given immediately as indicated These two are available in combination

PROSTHESIS*

Various types of prosthesis are temporarily essential in certain large reconstructions, including supporting bone and soft parts. They furnish

* By P C. Lowery

a necessary scaffold to support soft tissue and prevent contraction, pending the final introduction of bone and cartilage They are particularly useful in reconstruction when there is a likelihood of latent infection which would menace bone and cartilage introduced at this stage They are necessary for the introduction and application of skin grafts in the orbit, buccal mucosa and intranasally

Loss is rarely so extensive that it cannot be repaired with the patient s tissues and without the permanent use of foreign bodies. Such a result is not only desired but expected

Prosthetic pieces must never be left in soft tissues permanently This applies to all foreign substances such as ivory, celluloid metals and so forth.

It is highly desirable to mask the loss and permit the patient recently operated for malignancy involving both soft parts and framework to continue his associations and habits during the interval until his repair can be safely accomplished This is particularly true in gross involvement of the nose and its adjacent structures and the ears (Figs 127, 128 334)

There are occasionally badly managed clefts of the hard and soft palates which cannot be even partially corrected otherwise

The psychic value and blessing of the prosthetic eye has long been appreciated. This is particularly true since recent technical contributions to the muscle management in evisceration of the globe and the addition of acrylic shells to match the cornea iris and sclera to the implant in the capsule or to the reconstructed orbit.

Fundamentals of Oral Prosthesis. Restoration of the function of mastication is the first aim in repair of intra-oral injuries. When injuries involve the tissues of the oral cavity with loss of teeth and of bone the surgeon s aim in treatment is to restore the mouth to such condition that the patient will be able later to wear a satisfactory prosthetic appliance

In débridement, all teeth possible should be saved, especially those of strategic value Temporary prosthetic scaffolding, to assist in surgical reconstruction should be built as early as feasible, but it never should be worn if it retards healing or interferes with progress toward final surgical repair These appliances serve as mechanical means of maintaining the hard and soft tissues in better alignment. They should be of simple construction light weight, preferably removable, easily cleaned and, if possible made to assist in mastication.

The *early* insertion of a prosthetic restoration after loss of anatomic structures may be the means of preventing a malattempt at rehabilitation Patients frequently form comfortable habits which are not conducive to satisfactory final prosthetic results

Final prosthesis follows as soon as reconstructive surgery is completed and tissue tolerance will permit. The sooner function is brought to bear on edentulous areas the sooner the cortical bone will be formed Regeneration of bone rather than resorption is thus brought about.

Failure to use early prosthetic restorations in accident cases is depriving the patient of a necessary health service.

Definitions. *Prosthesis* (or prothesis) is the replacement of an absent part by an artificial one *Dental* prosthesis is the art of supplying missing teeth or parts of teeth by artificial substitutes. *Maxillofacial* prosthesis is defined as the treatment of and repair after injuries to the face and jaws including artificial replacement of those parts. Maxillofacial prosthesis is of two main types extra-oral and intra-oral.

Extra-oral prosthesis contributes greatly to the early psychologic rehabilitation of the patient. The ultimate aim however is surgical reconstruction of the loss or deformity Prosthetic appliances made of various materials used in dentistry accomplish this These appliances may be worn before the wound has completely healed. In cases in which the patient's condition does not permit subjecting him to further surgical measures, these devices may be worn permanently The skill and materials of the dentist are needed in the construction of artificial appliances to supply parts lost by injuries about the head, face and jaws. Extra-oral prosthetic appliances considered here are those used as substitutes for appendages of the head or parts thereof

Intra-oral prosthesis is dental maxillofacial prosthesis. Intra-oral prosthesis assists in restoration of the functions of mastication and deglutition and aids in speech. *Complete dentures* are a combination of dental and maxillofacial prosthesis because they supply a part of the alveolar process lost through absorption or injury and help to maintain the vertical and horizontal dimensions of the face *Partial removable dentures* may include replacement of lost parts of the jaws. *Obturators* and *velums* to close palatal perforations (acquired palatal defects) may be separate intra-oral appliances or may be attached to complete or removable partial dentures.

A combination consists of an extra-oral appliance attached to an intra oral denture.

An *interim surgical prosthesis* should be constructed as scaffolding to assist in surgical reconstruction and to promote regeneration of tissues, in all instances wherein they do not retard healing or interfere with regeneration of tissues which have been subjected to surgical measures or with final surgical operation They also improve functional efficiency and appearance with the object of rehabilitating the patient both physiologically and psychologically

Postsurgical prosthesis embodies the fundamental principles which govern complete and partial denture prosthesis as generally practiced. However the methods and technical procedures must be dictated by the *demands of the individual patient.*

Intra-Oral Prosthesis

Effect of Function. Function destroys, maintains or restores the facial expression of those who wear artificial restorations, depending on the dentist's ability to place and maintain the stress area of the denture

bases in advantageous relation to the traction of the muscles of mastication and expression

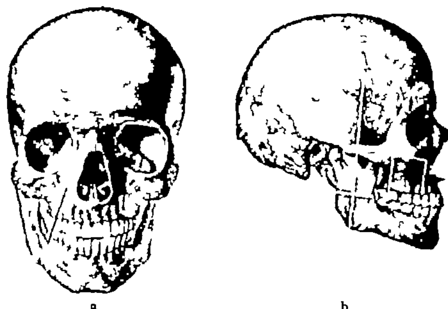


Fig. 98. *a* Lines of traction of masseter and internal pterygoid muscles *b* direction of stress on denture as determined by line of traction of temporal and superficial masseter muscles.

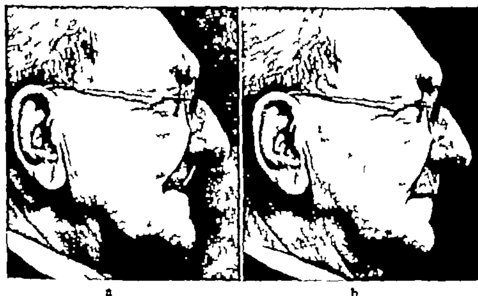


Fig. 99 *a*, Distortion of facial contour caused by excessive loss of alveolar process *b* facial expression restored by complete artificial dentures. (Teeth, Health, and Appearance.)

Anatomic and Cosmetic Relations. Facial harmony is directly dependent on muscular tone which in turn is dependent on position of teeth and relation of adjacent anatomic structures The origin and insertion



Fig. 100. *Left column*, The loss of facial expression caused by disuse atrophy; *right column*, restoration of facial expression following reconstruction of artificial dentures. (Lowery.)





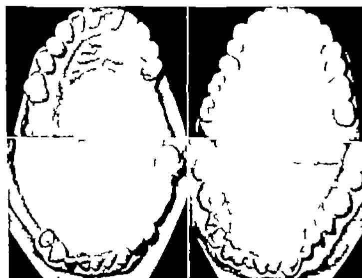


Fig. 101 *Left column*, Before and, *right column*, after restoration of a lost vertical dimension of 16 mm., this automatically restored the horizontal dimension, correcting a right mandibular deflection. (Jamieson.)

of the muscles of mastication and expression must bear the same relation to each other after the dentures have been inserted that they had before the injury perhaps, even the relation of these structures can be improved. The outline form and position of the denture base within the denture space as well as the alignment of the teeth direct the tension and support of the muscles about the mouth and are the means by which tension and support are secured and maintained Thus cosmetics depend on mechanics (Figs 98 99 100)

When the three muscular forces—of the external layer of the masseter the internal pterygoid and the temporal muscles—are coordinated their



Fig. 102. *a*, Distortion of facial contour caused by excessive loss of mandibular structure and consequent collapse of tissue. *b* Function restored the facial contour after reestablishment of mandibular position by means of a partial denture which also artificially replaced the lost structures the restoration was an aluminum-core vulcanite partial denture with wrought-clasp retention on the two remaining teeth (the lower left second and third molars) in an effort to prevent absorption caused by the weight of the denture the aluminum core was cast in two parts and jointed by malleting and burnishing to a union. A more recent restoration would have a hollow acrylic resin base or an acrylic base made with a stainless steel alloy core

combined force is in a vertical direction in the neighborhood of the second premolar first molar and second molar regions This direction according to observation is in a direct line with the fibers of the deep part of the masseter muscle and the vertical fibers of the temporal muscles To maintain facial contour and balance the resistance tension should be placed where nature intended it to be placed (Fig 98) which is the position illustrated. Thus muscle balance and physiologic function restore and maintain the facial expression of the individual

Figure 100 represents an excessive loss of maxillary alveolar structure It shows disuse atrophy of the muscles caused by prolonged habits of anterior mastication with infrequency of swallowing. A persistent effort to clear the throat was manifested by a peculiar cough with lips

closed. Correction of the mandibular position by means of complete artificial dentures replacing the lost structures, together with proper alignment of the artificial teeth restored the muscles to physiologic function.

Swallowing and Restoration Swallowing usually is an unconscious involuntary act. The patient suffering anatomic losses should be impressed with the value of swallowing with effort so that it will become

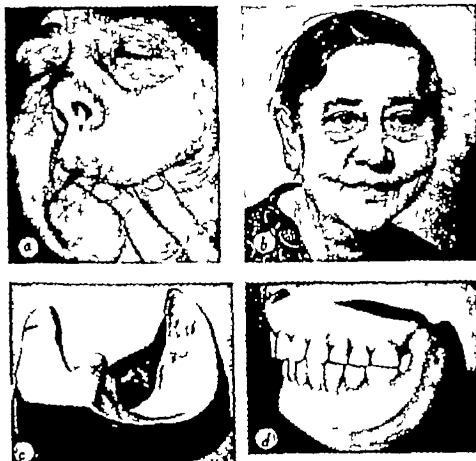


Fig. 103 *a, b c d* Edentulous patient with entire left mandible (from symphysis) missing treatment was by construction of complete upper and lower dentures, with extension of left side of lower denture to occlude at tuberosity with upper denture, and sufficient fulness on that side for stability A hollow acrylic resin bulb on the left side would decrease the weight of the lower denture. (Fitz-Gibbon)

habitual In this manner not only are the appliances seated under definite stress, but the function of the salivary glands is improved. Proper deglutition drains and stimulates the tissues of the oral cavity and aids in draining and ventilating the nasal and pharyngeal sinuses. It also aerates the middle ear through the eustachian tube by equalizing any differential in air pressure which may exist.

Some other results of restorations are represented in Figure 101

Prosthetic Materials. Many new materials have been introduced. Some have become indispensable for example, the hydrocolloidal im

pression material, plastic impression waxes, zinc oxide impression paste prevulcanized liquid rubber *stainless steel alloys*, and acrylic resin material especially methyl methacrylate



Fig. 104 Profile and full face views of patient before and after restoring of facial lines. *Left column*, Loss of expression caused by disuse following surgical resection of body of mandible from a point slightly anterior to the angle on the right side to the angle on the left side *right column* appearance following insertion of lower denture the restoration was accomplished with a complete lower denture of vulcanite with an aluminum core the impression was made to conform to the conception of its needs by carving. A superior denture would result today from an impression of plastic soft wax and fabrication of a lightweight, hollow acrylic resin denture base with acrylic teeth

Acrylic Resin Acrylic resin materials increase the efficiency of max illofacial prosthetic restorations because decreased material weight en courages health of tissue The weight is further decreased and appear ance improved when acrylic resin teeth are used. The smoothness of the

union between acrylic teeth and acrylic base materials tends to increase comfort of tongue and oral tissue, and it particularly aids speech The restoration may be made hollow by the use of a core in forming it This will decrease further the weight of the appliance In the past aluminum cores were used with vulcanite The choice today is in favor either of a stainless steel alloy core used with acrylic resin or of a hollow acrylic resin base used without a core How weight would be decreased today is pointed out in Figures 102 103, 104



Fig. 105 *Top* Intra-oral view—wound involving the antrum *bottom* replacement—partial denture of gold and acrylic resin. (Kingery)

Palatal Defects. The acquired defect is referred to as a "perforation" in contrast to the congenital cleft. The congenital cleft is in the median line, while the acquired perforation may occur in any area of the palate Most acquired defects can be restored surgically but a few require a prosthetic restoration. Such prosthetic appliances are of two types, the obturator and the artificial velum with variations.

Early restoration of function for the patient is most important this requires that temporary appliances be constructed and used until such time as permanent treatment can be initiated With an imperfect palate there is interference with both speech and mastication. An appliance worn early will prevent the abnormal muscular coordination which re-

sults from an attempt to perfect speech under abnormal conditions and also will prevent food from passing into the nares during deglutition.

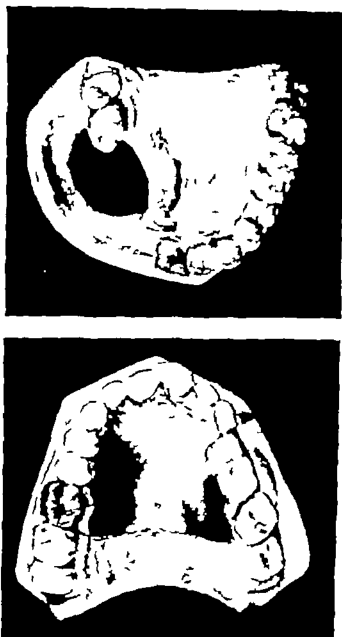


Fig 106 *Top* Wound involving the nasal cavity *bottom* replacement by partial vulcanite (Whitman)

The choice of design and material for use in a prosthetic appliance to correct an imperfect palate depends on knowledge of the normal function of the muscles and tissues surrounding the region of the loss and on knowledge of the physical properties of the various materials.

Some appliances relevant to the material of the preceding paragraphs are illustrated in Figures 105–109, inclusive

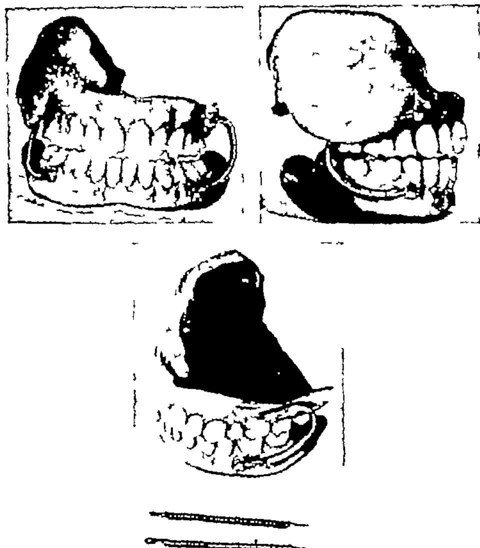


Fig. 107 Prosthetic reconstruction following large loss of right palatal, maxillary and malar structures construction was with vulcanite and a metal spring (Boos) With favorable relation of maxillary and mandibular ridges, this appliance now could be constructed with a hollow bulb acrylic resin base, so light that, with balanced occlusion of the teeth, the spring could be eliminated.

Construction of bulb of hollow acrylic resin is as follows Process in two parts then join together observing all principles of processing methyl-methacrylate. If rebasing is anticipated, a stainless-steel alloy core can be inserted. With careful technic, however rebasing of bulb type is possible.

Special Considerations. The importance of simplicity of design and accuracy of technical execution should be stressed. Building without a plan is, at best, a pastime At worst, it is a costly indulgence

The wrought clasp is first choice for mechanical retention of temporary appliances. It is resilient placing but slight strain on the abut

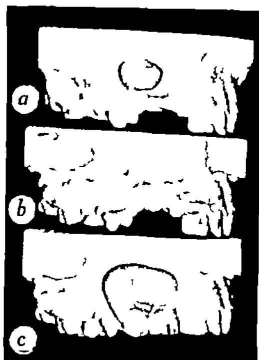






Fig. 108 In the case represented there was loss and regeneration of tissue following excision of a cyst. Intermittent pressure on the appliance in the course of mastication caused stimulation, which in turn brought about regeneration of tissue. Both mechanical and biologic principles should be utilized in repair

a, Representation of condition three months after operation and before prosthesis, *b* one year after insertion of prosthetic appliance; *c* removable acrylic resin appliance in position *d* palatal view of appliance *e* labial view of appliance (Donaldson.)

ment teeth, it is easy to construct and to adjust and entails few com plications when rebasing is necessary

It is often necessary to remove some teeth before construction of a final prosthesis Before the extraction of two or three teeth in a series the following rules should be observed Secure an impression pour a cast, make a splint of acrylic resin (with or without teeth) or of base plate with compound for an occlusal rest and, after the extractions place it over the edentulous region





Fig. 109 The wound that is represented entered the antrum. To prevent leakage of air under the denture, a gold ferrule was inserted through the denture base. As regeneration progressed, the gold ferrule and denture base were decreased.

The object of the splint is threefold (1) It predetermines and preserves the outline form of the ridges and muscular attachments and prevents muscular collapse with its attendant change in the temporomandibular articulation. (2) It acts as a surgical dressing to prevent reinfection. (3) It has all the advantages of an immediate denture in case of hemorrhage or postoperative discomfort

Still some more appliances for intra-oral prosthesis are illustrated in Figures 110–116 inclusive

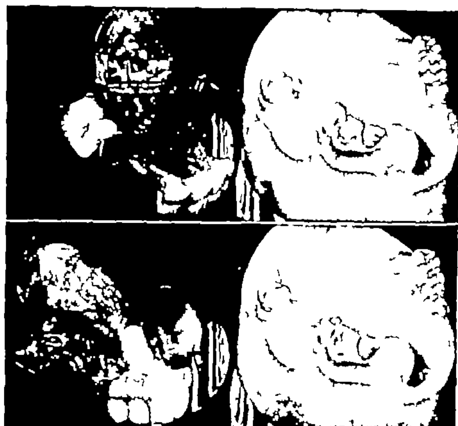


Fig. 110 Different views of a model and of an appliance for congenital cleft palate. Construction of the appliance methyl methacrylate with hinge. The objection raised to the hinge type of restoration is that it allows escape of air which affects the function of speech (Nelson) A similar design can be constructed without a hinge by attaching a hollow bulb.



Fig. 111 *a* Profile without appliance *b* profile with appliance *c* full face with appliance.

Past history of surgical procedures Operation on palate and lip in childhood resulting in a good surgical result but marked velar insufficiency

Treatment Premolars protected with cast bases for overlays. Slight dissection of lip for flexibility Appliance constructed with overlays for contour of lip cosmetic considerations, and speech (Fitz-Gibbon) This is an exceptional result. When space for anterior teeth is restricted, overlays fabricated with acrylic teeth may be made thin and still have strength and give good appearance.







Fig. 111 (continued) *d* Maxillary model showing velar insufficiency· *e* intra-al view of appliance showing position of bulb *f* full view of appliance. (Fitz bbon.)





Fig. 112. *a* Maxillary model *b* intra-oral view of maxillary condition *c* appliance in position.

Past history of surgical procedures One operation performed before patient was two years of age. Result, fair· extreme velar insufficiency and mutilation of posterior pillars.

Treatment Speech appliance constructed correcting velar insufficiency When setback" procedure for lengthening palate is impracticable, this type of prosthesis is indicated. (Fitz-Gibbon.)



Fig. 11 (continued) d Lingual view of appliance e lateral view of appliance f appliance on model. (Fitz-Gibbon.)



Fig. 113 *a*, Maxillary model *b* profile without restoration *c* occluding models *d* lingual view of appliance *e* superior view of appliance *f* full face without restoration *g* appliance in position *h* side view with appliance *i*, full face, appliance in position.

Past history of surgical procedures Two operations on lip two operations on palate.

Treatment Speech appliance constructed restoring facial palatal contours, functional occlusion, and speech mechanism (bulb) (Fitz-Gibbon.)

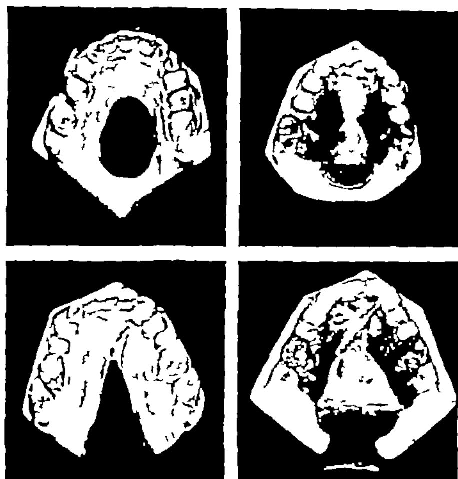


Fig. 114 *Left column*, Two types of cleft palate *right column*, appliance for each is a partial denture with soft velum replacing palatal and missing soft structure. (Whitman.)

Persons with cleft palates seem readily to tolerate, and adjust themselves to, this type of restoration. Soft velum vulcanite, when worn in the mouth for a short period, becomes unsanitary owing to its absorptive properties. Those who do the type of work represented here are hopeful of a more sanitary resilient material which will contribute to the more extensive use of this type of restoration.

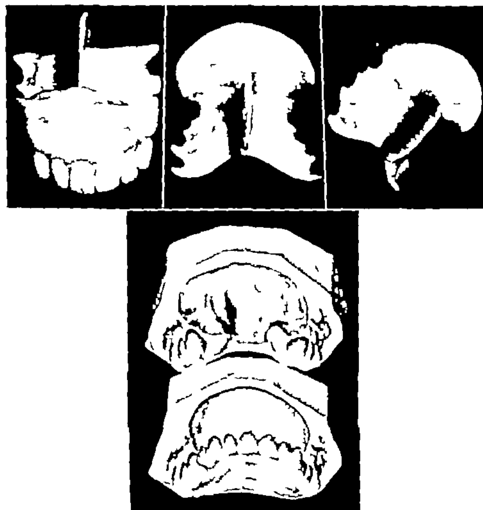


Fig. 115 Various views representing considerable loss of intra-oral hard and soft tissue. Former restoration was constructed of hard and soft velum vulcanite unsanitary and heavy Reconstructed of methyl methacrylate, hollow bulb in anterior portion by processing in two sections and joining. The pseudovomer replacement aids greatly in speech, and the light weight adds to comfort and efficiency



Fig. 116. Considerable loss of anterior mandibular hard and soft structure. Restored with gold and vulcanite partial denture. A more recent appliance would utilize an acrylic bulb to decrease the weight.

Extra-Oral Prosthesis

Maxillofacial prosthesis supplying appendages of the head or parts thereof will be considered. The surgeon from the first surgical intervention bearing in mind the need for subsequent prosthetic restora

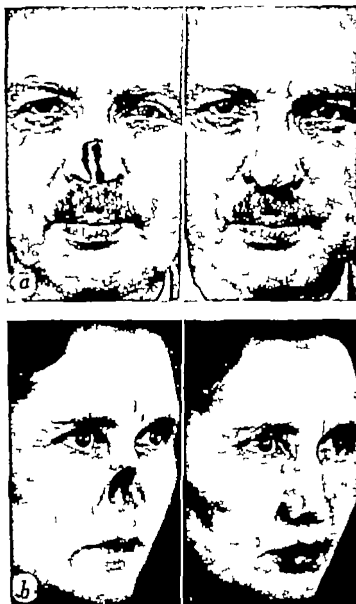


Fig. 117 *a*, Loss (left) and prosthetic replacement (right) of tip of nose; *b* loss (left) and prosthetic replacement (right) of major portion of nose (Bulbulian) These examples are of interim surgical prosthesis to be worn until replacement by autoplasty

tion can aid by providing areas of retention around the wound and can provide finishing lines in the shadows of the face where they will be least noticeable. Healing is of primary importance The appliance must not be so heavy as to retard healing nor may it irritate the tis-

sues and delay final plastic operations. The chief function of the temporary appliance during this period is to improve appearance and maintain the morale of the patient while acting as a scaffolding for plastic surgery

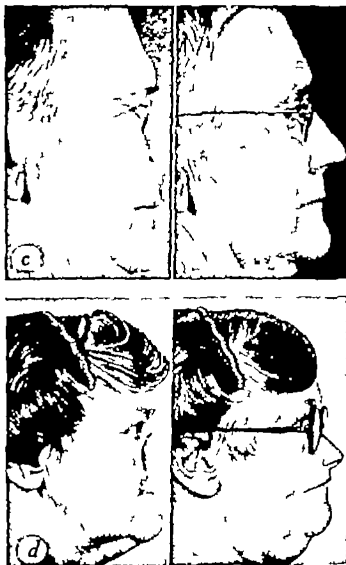


Fig. 117 (continued) c Loss (left) and prosthetic replacement (right) of entire nose d, loss (left) and prosthetic replacement (right) of entire nose and upper lip (Bulbulian) These replacements may be the ultimate result, depending on surgical and prosthetic judgment.

An ear a nose, a cheek wholly or partially destroyed, an eye or parts of the head and extremities can be supplied by artificial appliances made preferably of acrylic resin or prevulcanized liquid rubber

Technic of Prosthesis for Nose and Ear The making of a facial

Facial Mask Impression. MATERIAL AND METHOD

1 Measuring wire, same as that used for making profile
2. Cut out cardboard to fit portion to be walled off.
3 Carding wax or modeling clay placed at right angles to surface

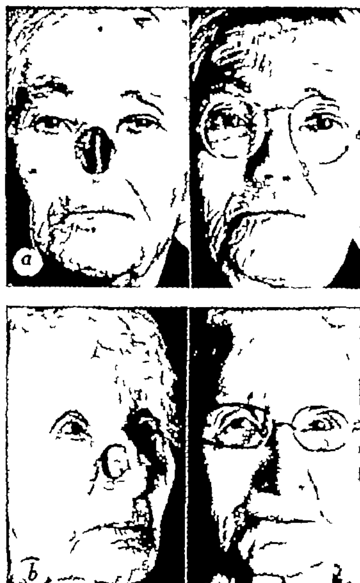


Fig. 118 Prosthetic replacement of nose. *a* and *b* Replacement constructed of latex compound. (F T Munson and D P Heron Am. J Surg., vol. 53)

of which impression is to be made to confine flow of impression material

4 Apply hydrocolloidal impression material stiffen with wire mattress chill with ice water through metal coil reinforce with plaster Do not apply hydrocolloid too hot it burns the skin as does wax Chill the tissues of the face by applying ice when heat is not well tolerated. Thoroughly dry the surface of the

face this will prevent discomfort when impression material is applied.

IMPRESSION OF SPECIFIC REGION Obtain an impression of the region to be restored and the adjacent tissues including the face or the side of the head This may be a direct impression taken with a hydrocolloidal material plaster of paris or soluble plaster Place gauze, cotton or soybean wool and cover with cellophane applied with surgical glue to prevent impression material flowing in unnecessary areas.

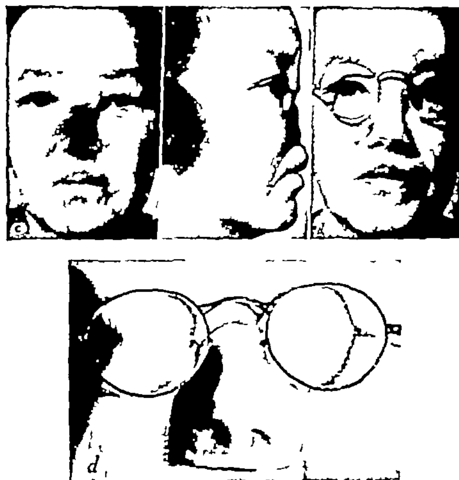


Fig. 118 (continued) Prosthetic replacement of nose c and d Replacement constructed of acrylic resin. (F T Munson and D F Heron Am J Surg., vol. 53)

IMPRESSION MATERIALS

1 Hydrocolloid has good elastic properties. It may cause distortion of soft tissues where undercuts are present.
2 Plaster of paris, if extreme accuracy of soft tissues is desired.
3 Soluble plaster
4 Plastic soft wax.

Casts and Moulages Plaster Stone and Wax Base Materials DIRECT INDIRECT METHOD

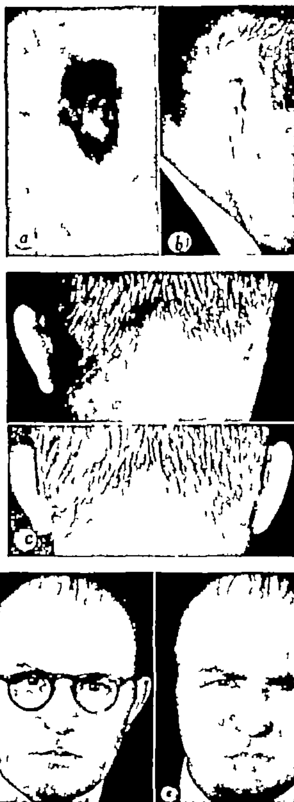


Fig. 119 *a* and *b* Site of defect *c* posterior view before and after prosthesis, *d* appearance of patient wearing prosthetic ear constructed of latex compound, *e* full front view showing loss of right auricle. (Bellinger.)

1 Obtain good front and profile photographs. If one ear is to be replaced mirror photographs of the remaining ear should be made.

2 Duplicate the master cast for a working model.



a b

Fig. 120 *a* Appearance of patient, showing loss of entire right auricle· *b* appearance of patient wearing prosthetic ear constructed from a latex compound. (Bulbulian.)



a b

Fig. 121 *a* Two views of an artificial ear constructed of prevulcanized, liquid rubber· *b* two views of an artificial ear constructed of gelatin.

3 Carve the missing member in wax on the working model This calls for sculptural ability If a nose is to be replaced, an im pression of a similar nose is frequently of assistance in sculpturing the new one A mask of the face or side of the head aids in indirect carving All finished borders must be planned so as not to appear conspicuous.

4 The size and shape must reproduce the missing member as faithfully as possible. Proper consideration must be given to the texture as well as to the color of the surrounding skin The color of the skin changes with the seasons.

5 Duplication of wax patterns is similar to the same step in complete denture service

MATERIALS

1 Prevulcanized rubber This material shrinks, consequently the wax pattern must be slightly larger



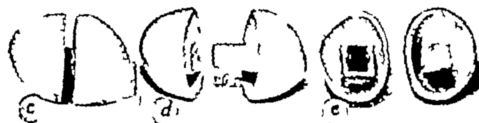


Fig. 122. A split prosthetic appliance with spring tension will serve to maintain the form of the orbital cavity for reception of a prosthetic artificial eye. *a* Natural eye· *b* artificial glass eye *c* and *d* views of an acrylic resin appliance in two pieces *e* spring in place to create and maintain tension on tissue. This principle may be used in various modified forms, a bulb in one piece may be used as a stent for surgical aid.

2. Methyl-methacrylate This does not shrink appreciably The methods of processing are directed by the manufacturers of the various materials

APPLICATION AND RETENTION

1 Ear Take advantage of the ear canal, of any remaining parts of the ear and of any lined undercuts which the surgeon may provide

2 Nose Same as above Spectacle frames are made of acrylic resin without the rims or metal lenses of unbreakable glass. The attachment of the prosthesis to the spectacle frame must result in proper balance

Examples of Prosthetic Appliances for Lost Noses and Ears See Figures 117–121 inclusive

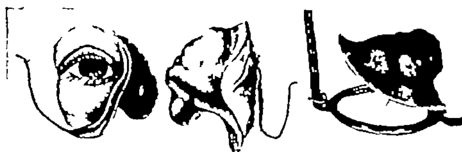


Fig. 123 Three views of an appliance. The method of attachment and degree of replacement are dependent on the extent of the loss. (Kazanjian.)



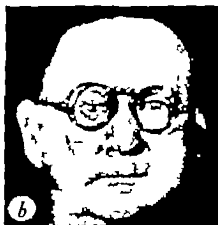




Fig. 124 *a*, Appearance of patient without appliance attached to eyeglass frames *b* and *c* patient wearing the appliance. (Kazanjian.)

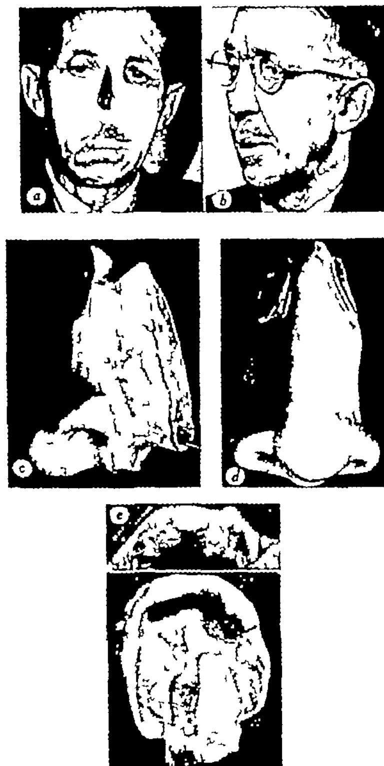


Fig. 125 *a*, Extra-oral view *b* three-quarter view with all appliances in position *c* lateral view of nose, showing method of retention *d* full view of artificial nose restoration, *e* intra-oral view and superior view of speech appliance.

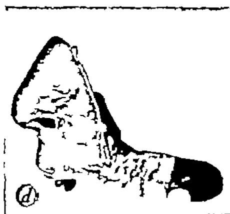
Condition of oral cavity complete destruction of soft palate and part of hard palate vomer turbinates, triangular cartilage, median walls of antrums, and parts of the sphenoid missing ethmoidal, frontal and maxillary sinuses exposed remaining teeth extremely mobile and suppuration around them.

Treatment and prognosis removal of all teeth trimming of process, anterior maxillary flap closure (surgical) for support of denture. Construction of speech appliance, denture, and nose improved speech and appearance. (Fitz-Gibbon.)









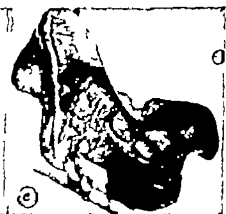


Fig. 126. *a*, Edentulous patient with loss of entire nose and upper lip *b* and *c*, patient wearing prosthetic appliance *d* and *e*, two views of combination prosthetic appliance material is vulcanite methyl-methacrylate would be a cosmetic improvement. (Boos.)

Combination Prosthesis

These combinations are as varied as the individual patient. There is a demand for this type of replacement for temporary use in rehabilitating the patient both cosmetically and psychologically Far too little attention is being given to the importance of such restorations

After the final surgical procedure, or in cases in which autoplasty is not advisable, the prosthodontist should make every effort to replace the missing structures with a permanent prosthetic appliance. In this effort creative ability is of primary importance

Examples are illustrated in Figures 125 and 126

The author wishes to add to this presentation technic and excellent prostheses some further considerations.

It is beyond the purpose of this text to discuss prosthesis of the ex tremities This is the responsibility of the orthopedist and others.

We have believed for many years that we are warranted and obligated to relieve surgically the physical and mental pain of a patient with an obviously incurable malignancy, if it is reasonably probable that we can obtain some months of comfortable living and a more bearable con clusion Such a patient with visible parotid involvement and a general metastasis of a badly managed basal cell carcinoma is presented in Figure 127

Another necessity for prosthesis is the consideration determining the reconstruction of the patient in Figure 128 She was operated on for a cancer involving the nasal bone, nasal process, adjacent cheek anterior ethmoid cells and the tissue about the attachment of the internal rectus muscle

It is apparent that the area must be under observation for a mini mum of one year or longer before local surgery is undertaken Such a patient is unwilling to appear in public with a mask or dressing during this period. The psychic damage is great and may seriously determine the ultimate outcome

A prosthesis of the type presented in Figure 128 usually permits patients to resume comfortably their economic and social contacts.

We are frequently presented with an adult who suffers a prognathism and a consequent disagreeable profile as the result of a badly managed double cleft palate in infancy There is a serpentine maxillary alveolar process with a misplaced poorly developed premaxilla or none at all. Nothing other than a prosthesis can furnish the desirable support re gardless of the volume and quality of the upper lip Such a situation is presented in Figure 129

The patient in Figure 130 suffered a double cleft lip and palate with a protruding premaxilla no columella, facial asymmetry a contracted orbit microphthalmia and a narrow palpebral slit The latter two con ditions are corrected satisfactorily by a canthoplasty and the installa tion of a plastic shell which moves with the small globe.



Fig. 127 Patient with large, ulcerating, squamous cell nasal carcinoma and an inoperable metastasis in the parotid gland, cervical glands and thorax.

Fig. 128 *Top* An ulcerating cancer of the nasal bone, nasal process, adjacent cheek, anterior ethmoidal cells and the tissue about the attachment of the internal rectus muscle. *Bottom*, Result of radical excision prosthetic restoration permitting social and economic contacts during the period before local reconstruction is indicated.

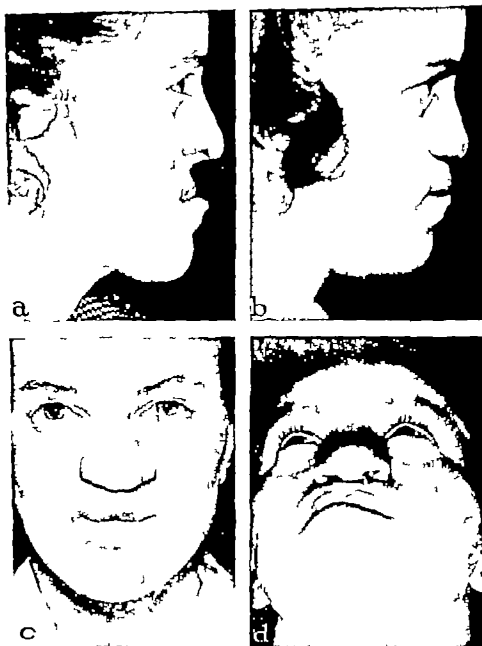


Fig. 129 Prosthetic restoration of a prognathism following a badly operated cleft palate during infancy *a* and *b* Result of a properly constructed prosthetic denture. *c* and *d*, Anterior views of the mouth and nose after prosthetic reconstruction. The lower half of the nose, including the columella, requires reconstruction.

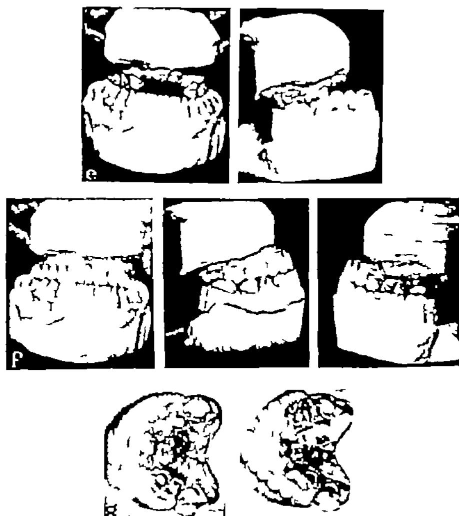


Fig. 129 (continued) *e* Dental impressions on an articulator· *f* onlay denture added on the articulator· *g*, onlay prosthetic denture.



Fig. 130 *a*, Facial asymmetry narrow palpebral slit on the right side with a microphthalmia. *b* Result of correction by canthoplasty and the implantation of a plastic shell prosthesis upon the small globe.



Chapter IV

OPERATIVE PROCEDURE AND TREATMENT

PREPARATION OF FIELD

Infection is the greatest enemy of all fine plastic results and in some procedures absolutely prohibitive of any desired results The preparation of the field cannot be too scrupulous

For prophylaxis order *sulfonamide drugs penicillin* or other indicated drugs in the presence of latent infection.

The site for removal of a flap from the *arm chest* or *abdomen* is shaved and scrubbed with green soap gauze and water or germicidal detergent A soap poultice is applied to the area for several hours. This is removed in the operating room, and the part thoroughly cleansed with ether and alcohol. It is then painted with a 1.5 per cent solution of iodine. This is removed with alcohol Recently burned areas may not tolerate irritating substances (iodine mercurials, and so forth) Thorough cleansing with soap and gauze ether and alcohol must suffice in these cases.

Preparation of the *face* varies somewhat The day before operation the face is steamed and thoroughly cleansed with soap and water The face is sponged in the operating room with ether and painted with 1.5 per cent iodine solution. This is allowed to dry and is then removed with alcohol

The *nose* is prepared carefully for rhinoplasty (p 560) All hair is clipped from the nostrils. The interior is packed with cotton pencils wrung out of a 1 2000 solution of *epinephrine hydrochloride* contain-

ing 10 per cent of cocaine The entire nasal area is injected subcutaneously with a small amount of 0 5 per cent procaine and epinephrine hydrochloride 15 minims to the ounce.

Anesthesia without ischemia can be obtained by application at two points. A cotton tipped applicator dipped in epinephrine hydrochloride (1 1000) and rubbed in cocaine powder is inserted between the midpoint of the middle turbinate and the septum, against the cribriform plate (anterior ethmoidal nerve) A second applicator is inserted upward and backward, diagonally across the middle turbinate, against the anterior wall of the sphenoid bone and the lateral walls (sphenopalatine ganglion) The use of local anesthesia does not materially affect healing in the region of operation. After anesthesia the vestibule is thoroughly cleansed with ether and alcohol and packed with gauze saturated with 70 per cent alcohol. These packs are finally pushed beyond the area of incision and the vestibule is painted with 1 5 per cent tincture of iodine

The sterile drapes about the field are fixed in place with "surgical glue"

CHOICE OF ANESTHESIA

Most plastic procedures can be satisfactorily performed under local anesthesia This can be produced by either infiltration or nerve blocking.

We find a 0.5 per cent solution of *procaine* containing 15 or 20 minims of *epinephrine hydrochloride* to the ounce (30 cc.) highly satisfactory It is rarely necessary to use the entire ounce of solution. If more is required, it is used without epinephrine. Not only is satisfactory anesthesia obtained, but ischemia is produced, which facilitates accurate work and greatly minimizes the time required to obtain a dry field before dressings are applied.

The procaine is preceded by *pentobarbital sodium* (nembutal) by mouth 0 1 to 0 2 gm. (1½ to 3 grains) a half hour before operation and supplemented by *morphine* if required

Certain types of patients, as well as certain types of surgical procedure, are best handled under general anesthesia. There can be no fixed rule on this subject. Just as each case in which plastic surgery is performed constitutes an individual problem which cannot be solved by a fixed formula, so the choice of anesthetic must be suited to all the conditions of temperament and surgical requirements Tribromethyl alcohol (avertin) by rectum, preparations for intravenous use intratracheal ether and nitrous oxide, and so forth all must be considered

INCISIONS

A clean incision at a right angle to the skin surface made with a sharp knife and minimal trauma is the most satisfactory If the wound is carefully approximated with slight eversion of the skin edges, the best result is obtainable Beveled incisions have been periodically ad

vocated for many years, but are difficult to approximate accurately and have only theory with nothing in fact, to recommend them.

HANDLING TISSUE

Rough handling of tissue contributes to shock and materially affects the time of healing and the end result.

1. Use fine hemostats (mosquito type)
2. Include the smallest possible amount of tissue with the bleeding point.
3. Use the finest ligatures compatible with the procedure
4. Do not repeatedly use *tissue forceps* with sharp coarse teeth.
5. Handle all tissues with sharp hooks whenever possible.
6. Sponge gently Do not wipe use gentle pressure
7. Utilize a suction pipet when one is available

SUTURES AND CLOSURE

Horsehair is the ideal suture for fine skin closure. It has considerable tensile strength elasticity and no capillarity It can be obtained in many sizes ranging from very fine to fairly coarse strands The increasing difficulty in procurement limits its use A nylon suture appears to have the same qualities and may be substituted for it. Davis and Geck have produced a fine dermal suture, fixed on an atraumatic needle in size ranges as small as 8–0 It is perfect, except for the absence of elasticity Allowance for this may be made in tying. Many surgeons prefer silk. The prepared material has all the qualities of hair except elasticity The type of suture material used is not vital to success, if its qualities are appreciated.

The method of using the stitch—the closure—is of much greater importance than the suture material. It is important that the closure be effected *without excessive stitch tension* This can be accomplished by free undercutting of the edges, the use of relaxation stitches in the under surface of the skin and underlying tissues, and the use of relaxation devices on the skin surface.

Relaxation Procedures. Several methods of obtaining proper relaxation are useful for this work. If the defect is small a few interrupted catgut sutures passed through the deep layers of the skin or subcutaneous tissue about ¼ inch (about 0 6 cm) from the wound margins serve the purpose. If it is desirable to use and to remove the tension sutures or if a somewhat larger defect is to be closed, the method of *R L Dickinson* is useful (Fig. 131) Silkworm-gut or dermal suture is passed as illustrated in the diagram and tied over rubber tubing a glass rod or a gauze roll.

The *Lane* stay suture is ideal for relaxation and approximation of the muscle and mucous membrane in the lips and cheeks. It provides firm coaptation of these tissues and, because its *long residence without visible scar* is possible furnishes a perfect protection against separation or stretching until organization of the wound is completed

Blair's substitute for this stitch is simple and efficient (Fig. 132) We modify it to eliminate the skin entirely The skin is prepared for its ultimate independent closure by slightly freeing its incised margin from the underlying soft parts thus permitting slight eversion of its edges The stay suture passes beneath the skin

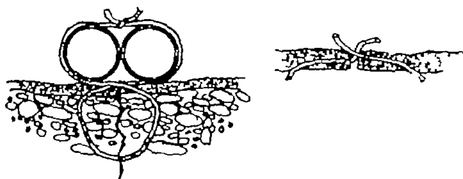


Fig. 131 Removable tension suture which does not produce cutaneous scar (Dickinson.)

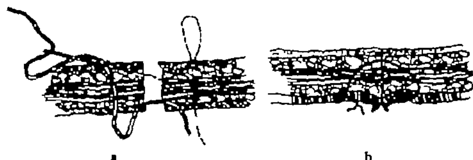


Fig. 132. Modified Lane stitch application to lips and cheek (Blair) *a* Making of the stitch *b* complete.

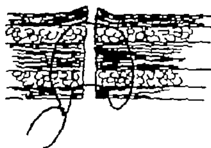


Fig. 133 Modified Lane stitch (author)

Closure of Large Defects. The closure of large defects, such as result from the removal of pedicled flaps from the arms requires extensive undercutting *of the skin* and powerful *traction* The author routinely uses the *Halsted* breast stitch which has been commonly described as the "far near near-far" stitch. A long strand of No 2 chromic catgut is used. It is first passed through the subcutaneous tissue, so as *not to include the skin surface* about 2 inches (about 5 cm) from the wound

margin on one side then it is similarly passed about ½ inch (about 1 cm.) from the wound edge on the opposite side then passed in the same location on the first side and finally passed about 2 inches from the margin of the opposite side in the same manner as first described. Two such stitches properly placed in a defect 4 to 6 inches (about 10 to 15 cm.) long and 3 inches (about 7.5 cm) wide allow sufficient traction to complete a closure Frequently a small circular slough is observed about the deep insertions of this stitch This results from a

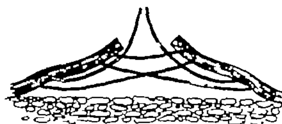


Fig. 134 Strong traction stitch for closure of large skin opening (Halsted)

strangled blood supply after the strong traction. If redness appears at this point the suture should be cut where it passes beneath the skin edges The stitch has largely served its purpose by the third day and such cutting does not, as a rule, impair the result (Fig. 134)

Two other sutures that can be used for approximation are shown in Figures 135 and 136



Fig. 135



Fig. 136

Fig. 135 Simple approximation suture. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Fig. 136 Double-twist knot. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Relaxation without Sutures. Several methods of surface relaxation with or without approximation sutures are useful, and occasionally one of these constitutes the only method of managing a wound which should not be sutured. The simplest of these is the use of adhesive strips applied parallel to the wound edges to furnish anchorage for stitches or lacing. Narrow strips of gauze applied with collodion at a right angle to the wound edge serve the purpose perfectly The author routinely uses this procedure after the removal of skin stitches on the second or third day

Excellent and easily gauged relaxation can be obtained by the use of muslin strips to which hooks have been sewed and which are applied to the skin with Mastisol or any of the good surgical glues. Braided

silk is then laced through these hooks or rubber bands are stretched across them to produce the desired tension (Fig. 137)

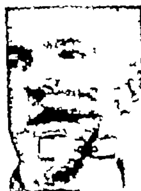


Fig. 137

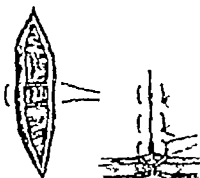
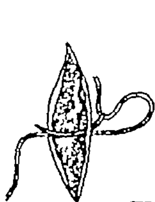


Fig. 138

Fig. 137 A method of surface relaxation by use of collodion or adhesive strips, used in management of a wound. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Fig. 138. Horizontal mattress suture (Ferris Smith Reconstructive Surgery of the Head and Neck Thomas Nelson and Sons.)

A narrow strip of adhesive tape applied beneath the chin carried around the angles of the mouth, crossed over the nose and applied to the forehead furnishes ideal relaxation of the lips



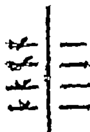


Fig. 139

Fig. 140

Fig. 139 Vertical mattress suture (McMillen)
Fig. 140 Continuous vertical mattress suture (White)

The manner of approximation of the skin edges and the subsequent treatment of the stitches and the healing wound largely determine the quality of the results. Sutures must be *properly passed* and *lightly tied* if fine results are to be obtained Numerous useful and efficient methods of closure are available

Interrupted Sutures; Horizontal Mattress Sutures. These are preferred about the face It is good practice to evert edges slightly with mattress sutures and complete the approximation with a simple suture either doubly twisted or tied. The use of interrupted sutures permits accurate control of tension and removal of a tight or infected stitch without disturbing the remainder of the repair (Figs. 135, 136 138)

Vertical Mattress Sutures. The "on-end" or vertical mattress suture of *McMillen* furnishes both relaxation and approximation. *Blair's* modification of this technic to produce eversion of the wound edges furnishes an ideal suture (Fig. 139) A rapid method of applying this vertical mattress suture without interruption is described by *C S White* (Fig. 140) This must not be tight, it will cut off the blood supply at the edges.

Another excellent method is the *subcuticular stitch* described by *Halsted* The suture is first passed through the whole skin at one end of the wound and fixed by a knot or a shot. Subsequently it is passed through the deep layers beneath the epithelium to emerge, finally on the skin surface at the opposite end of the wound, where it is again



Fig. 141 Halsted's subcuticular stitch.

either tied or shotted The most satisfactory results follow the use of a removable suture material (Fig 141)

DRESSING AND CARE

The immediate dressing and subsequent care of the wound are as important as the operative technic. It is not possible to support a fixed rule for this procedure since the problem varies with the location of the wound and with each case Some dressings are changed daily to permit inspection and some at intervals of several days those on split grafts on the fifth to the seventh days normally and those on free full thickness flaps are not opened until the twelfth day

Moist and macerating surfaces are treated satisfactorily with aluminum.

Oral and Nasal Drainage. Areas about the mouth and nose demand entirely different management from those about the cheeks forehead, neck and other body surfaces. Secretions from the oral and nasal cavities frequently contaminate the wound unless precautions against this accident are practiced Wounds inside and about the mouth and on the nostrils and small repairs about the face are painted with compound tincture of benzoin and exposed to the air *Stitch lines in the mouth cheeks and palate do best when not interfered with in any way* The mouth is frequently cleansed with an appropriate wash

Serous drainage during the first twenty-four hours is carefully sponged away from the surface wounds with small cotton swabs soaked

in hydrogen peroxide, and the wound is kept scrupulously clean. A stitch line is never rubbed or swabbed but the secretions and crusts are soaked off and gently separated. The knots of fine sutures must be plainly visible at all times.

The author prefers alcohol as a first dressing and continues with a dry dressing subsequently.

Management of Flaps. *Pedicled flaps* are dressed dry either with gauze or with gauze saturated with physiologic solution of sodium chloride during the first forty-eight hours. Dry dressing is used after the serous drainage has ceased. The dressings are sufficiently voluminous and are fixed by smooth firm bandaging. The dressing of *free skin flaps* is discussed under the heading of Skin Grafts (p 19). All special dressings will be discussed with the surgical procedure demanding them. *Ischemic flaps* are immediately returned to their origin and are not utilized until an adequate blood supply is assured.

Cyanotic flaps can be managed variously. (1) The flap margins may be trimmed sufficiently to increase the tension or "stretch" when it is sutured. This restricts capillary inflow and usually corrects the condition. (2) Multiple stab wounds or "pie cuts" may be made to permit venous drainage. (3) A pressure dressing may be used. The efficiency of the dressing and the requirement it must meet can be determined before applying the dressing. The pressure is estimated and depends upon the dresser's experience. (4) *Massage* is *harmful* to the flap unless used briefly.

Refrigeration. Proper elevation and position of the part are essential. Refrigeration is frequently helpful.

Removal of Stitches. Tight stitches and any stitches surrounded by reddened areas or other suggestions of infection should be removed immediately. All surface stitches in exposed surfaces are removed at the end of the *second* or *third day*. Two or three stitches are removed, and the area is supported by a narrow strip of gauze held in place with collodion across the wound at a right angle to the line of union. This procedure is repeated until all stitches have been removed. These gauze supports are replaced as rapidly as the edges begin to separate and are maintained for six weeks or longer to prevent stretching of the scar. This is regarded as the physiological period of complete scar formation and softening.

Complications. The infective accidents and other wound complications are treated in accordance with accepted practice and that which has been useful in the surgeon's experience. Flaps and grafts on infected bases are best treated with frequent *saline dressings* and indicated drugs. Strong antiseptic dressings are fatal to recently transplanted free flaps.

PLANNING TREATMENT OF SCARS

It has already been stated that the perfection of an organized scar depends on many factors. Clean incisions at a right angle to the skin surface, sufficient relaxation, careful approximation with slight ever-

sion of the skin edges, proper passage tying and early removal of stitches, and gauze collodion support of the wound together with intelligent dressing are the principal factors determining the result. Quality

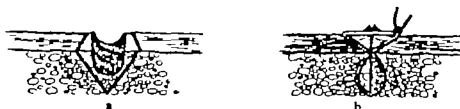


Fig. 142. Use of oblique incisions for the excision of a depressed scar (Davis) *a*, Approximation of these lines of incision raises the surface level to allow for subsequent contraction. *b* The wound approximated.

of the skin is also a great factor Some types of skin refuse to yield a fine scar despite scrupulous attention to all these details.

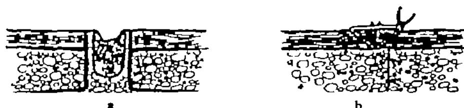


Fig. 143 A method of using a deep part of the scar as a foundation for the skin (Davis) *a*, The dark lines indicate the incisions the shaded parts, the scar *b* The scar involving the skin has been excised the skin, undercut and slid to approximate over the deeper part of the scar

Depressed Scars. These result from improper suturing of the under lying layers and the skin from loss of tissue and subsequent contraction from infection or from failure of proper union in the deeper layers.

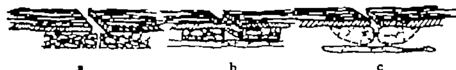


Fig. 144 Method of Aymard (Davis) *a*, The dotted lines show the usual method of separating the skin. The fat from each side is approximated and the skin sutured over it. *b* The blocks of fat outlined by the incision remain attached to and are approximated with, the skin. *c* The fat flaps are rolled in and sutured, and the skin is closed over this foundation.

Several satisfactory methods of dealing with this type of scar are illustrated in the accompanying diagrams (Figs. 142 143 see also Figs 158 159 239 549 *b*)

Broad, Smooth Scars. Usually these are slightly depressed, but may be level with the surrounding skin surface They may be fixed to the under

lying tissues, but are usually soft and easily movable. *These scars never should be excised and replaced by skin grafts* They are best corrected by multiple partial excision The smaller ones may be excised, and the borders approximated after free undercutting (Figs 144, 145)

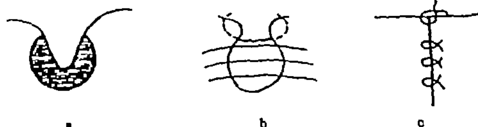


Fig. 145 Blair's method. *a* The lined area indicates tissue excised *b* sutures inserted *c* defect closed.

The method of partial excision suggested by *Morestin* and warmly advocated by Davis gives excellent results It depends upon repeated stretching and subsequent relaxation of the surrounding skin and hence must be accomplished in several stages An elliptical part of the scar



Fig. 146 Contracted scar This may be corrected in many cases with a Z plastic (Fig. 562) If a thick split skin graft is used, its approximating edges should be staggered as in a Z plastic, to prevent linear contraction.

as large as will permit suturing of the remaining borders is excised, and the margins are sutured. This process is repeated at intervals of several weeks until only a fine linear scar remains.

Contracted Scars. These are the sequels of deep burns, ulcerations and infections extensive traumatic tissue losses (Fig. 146), and failure to make staggered suture lines in effecting the closure

The repair of this disability frequently presents a most difficult problem and taxes the ingenuity and imagination of the surgeon. *The area of loss resulting in the scar is always considerably greater than the area represented by it* Nothing can be more astounding to the novice than the defect resulting from the removal of an apparently small, contracted scar of a burn from the neck. The original loss has been large and the contraction has depressed and partially fixed the chin by stretching the skin upward from the chest and downward from the margins of the mandible The line of fixation or anchorage is the narrow area of contracted scar in the center Its removal leaves the entire front of the neck bare from the border of the mandible to the clavicle!

The disability can be corrected only by a Z plastic operation full thickness skin graft or pedicled flap

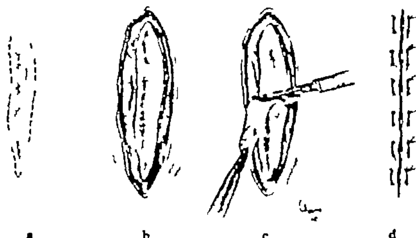


Fig. 147 Retracted scar· Poulard's correction of *adherent* and *depressed* scars. *a* The lined area indicates the depressed scar· the dotted line, the skin incision about the scar *b* The skin is freely undercut about the scar mass. *c* The epithelial surface of the scar is removed. *d* Approximation with mattress sutures everts the skin.

The Z plastic procedure is the choice in the majority of cases.

The depressed adherent scar is readily corrected by the Poulard procedure described under Figure 147

Hypertrophied Scar and Keloid. An empiric distinction is made between hypertrophied scar and keloid The former may be defined as an excessive production of fibrous tissue within the limits of the wound while the latter is exactly the same process in the wound, plus a similar invasion of the surrounding skin This invasion may assume considerable proportions (Fig. 148) in both linear extent and thickness.

Such scars consist of a hard, fibrous growth in which there are well developed small blood vessels and rich fibroblastic cell growth between the bundles of fibrous tissue The growth is usually red smooth and shiny and is occasionally nodular It frequently is the site of an itching, stinging, burning sensation Because of the great frequency of its oc

currence and recurrence in patients with extensive burns, and because of its rare appearance in white people without this lesion, one is led to believe that its presence must depend on some permanent chemical changes. Nothing is more embarrassing than its presence in wounds about the neck and face. Hypertrophied scar is usually self-limited in duration and gradually disappears in the course of a few months

Management of Keloid Many treatments have been advanced for the control or removal of keloid. The results are frequently indifferent and disappointing. *Morestin s* method of repeated excisions yields pleasing results in some instances and nothing whatever desirable in others In fact, the bulk of the mass is increased in some cases. The excision should be made within the borders of the tumor

The author has had an occasional desirable result from *massage* of the area of the new scar with 5 per cent *pyrogallic acid ointment* The



Fig. 148 Hypertrophied scar and keloid in th n.

application is discontinued when evidence of irritation appears and is resumed again when it disappears This process is continued for several weeks *Roentgen and radium therapy* immediately before and after excision have yielded the best result.

Large areas are treated by excision and grafting, with full thickness free flaps or pedicled flaps. This procedure is supplemented by radiation to prevent the excessive scar border which forms about the graft.

This may be followed by multiple excision when urgently indicated.

LANGER'S LINES

Much has been written and said during the past seventy five years about Langer's lines A clear exposition of the structures concerned, their anatomical distribution and their behavior under certain pathological and surgical conditions, has not been properly made and em phasized. Much that has been said about the value of incisions in these

lines is true and desirable but the conviction that incisions across these lines invariably produce stretched, bad cosmetic scars is not correct. The traction—"pull"—on some such scars is variable in direction. The poor results depend in most instances on added factors which are controllable by the surgeon and ignored in the large percentage of instances

These lines are readily determined on the scalp trunk and much of the extremities in most cases They have been accurately determined for the average face lips, and so on. There are cheeks and lips however in which they differ materially from the standard diagram

There are frequent lesions on the cheeks and lips which cannot be properly removed between incisions along these lines The plan may be such as to take partial advantage of these lines, but the cosmetic result, which frequently is the total purpose of the procedure depends upon both the operative and postoperative management by the surgeon.

The relaxation should be maximum. The subcutaneous tissue should be closed in layers with 00000 plain gut or chromic gut if the tension is marked The stitch lines are placed in staggered layers, if possible. The skin is relaxed with frequent 00000 plain gut sutures passed through the derma far enough from the edge to evert the skin edges slightly as the suture is properly tied. The skin is closed with *carefully passed and tied* 0000 dermal sutures placed at 5 mm intervals. General relaxation in direction of the tension is obtained by use of a wide (1½ by 6 inches) small mesh gauze strip fixed with collodion to one side traction on it toward the suture line and then similar fixation on the opposite side This strip is maintained several days after the sutures are removed. This is done on the second and never later than the third day despite the fact that actual union is just beginning The raw edges are already adherent with serum and so forth. Three or four stitches are removed and a gauze strip is applied across the wound. This is repeated *to remove all skin stitches. The relaxation gauze strip is not removed,* since it has not been cemented over the stitch line. Small openings are made across it to permit stitch removal All these gauze strips are renewed as often as required. They are left in place for six weeks, a minimum time for fibrous tissue formation its contraction and relaxation

An excellent review of the original and subsequent researches determining the fibrous tissue structure of the skin and its behavior and some added confirmative research is the basis of a monograph by Shaw and Copenhaver The author has drawn freely from this in the following discussion and acknowledges his gratitude

Relation of Lines to Fibrous Tissue This was suggested by Cloquet in 1816

Fiber Alignment This was first postulated by Dupuytren (1834) who observed chest wounds caused by a large awl on an adult who had attempted suicide Wounds produced by the same instrument on a cadaver produced slits which, in certain regions of the body were aligned in the same direction

Malgaigne (1838) repeated Dupuytren's research and described a pattern of the entire body He noted that triangular, rather than slit wounds, were produced by the same awl in regions where the linear wound pattern changed suddenly

Langer reported in 1861 extensive experiments on the *cleavability, tensions elasticity* and ability of the skin to *swell* He also charted lines on the body surface representing fiber patterns, and called them "lines of cleavage" and "lines of tension." He repeated this on the *newborn* demonstrated *variations* in the *adult pattern* and noted the variations on the *extremities and hand* He also described *clefts* crossing each other in the same wound of the thick skin of the back

Microscopic sections, both parallel and across the clefts, demonstrated the longitudinal and divided arrangement of fibers The more definite the cleavage the more parallel the fibers, the long dimension of their rhomboid distribution being the direction of the cleft.

Elasticity—Retraction

Langer stated (1) that skin retraction results from its elasticity and that the degree depends upon the normal existing tension (2) *"Retracting tension* varies with the *length and depth of incision freedom* of the skin or its *firm attachment* It varies more when the *lines of cleavage* are *crossed* than when they are *parallel*, also *with movement* and changes in *volume* When volume increases rapidly, *striae* result from rupture of the fibrous bundles "The fibres are all so arranged that no muscle tension has to counteract the extension of a skin bundle directly while all fibres in the excursion-direction of a joint cross sometimes transversely sometimes obliquely

"Therefore all folds of the skin produced following the contraction of a muscle, exhibit the cleavage direction An apparent exception is seen in the flexor surface of elbow knee and ankle, for the skin at these joints is stretched only on one side while the joints cannot be bent to both sides, like the wrist for example.

The connective tissue has the shape of latticework stretched evenly in a plane. The meshes are elongated diagonally in the shape of wide or narrow rhombuses. The fibers of the mesh are parallel in direct proportion to its width They group themselves in streaks which encircle the trunk and limbs in belts or spiral twists

It can be shown that everywhere in the skin except in the scalp palms of the hand and soles of the foot there is tension of varying degree. When full thickness grafts and flaps are cut, they retract. The tension is determined by the contents and by the movements of the joints. The tensile radii reach their limit near the median line on the trunk and at the middle of the joint length on the extremities

Elasticity

Skin has great elasticity in spite of the resistance of its connective tissue structure. This decreases with the burden or volume. A skin that



Fig. 149 Langer's lines (these lines in infants give the clearest and simplest patterns) Puncture wounds with spikes demonstrating the fiber pattern, cleavability and lines of tension in the skin. (Courtesy of Drs. Darrel P Shaw and W H. Copenhaver.)

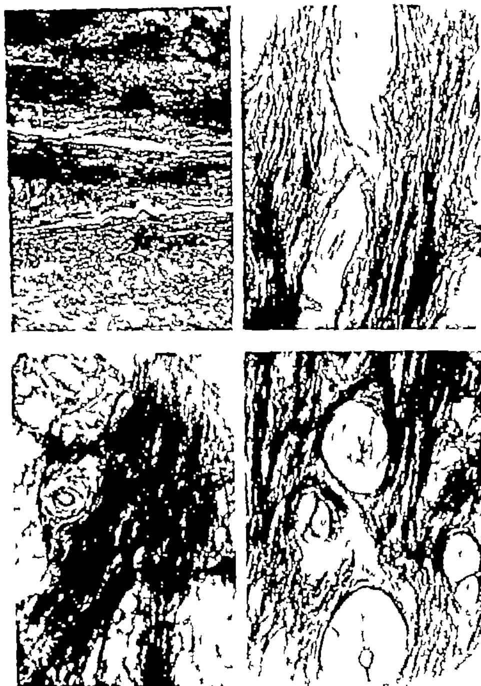


FIG. 150. Microphotographs showing a fiber arrangement in sections across and parallel to the cleft. The section across the cleft shows a divided arrangement, and that parallel with the cleft a longitudinal one. (Courtesy of Drs. Darrel P Shaw and W H. Copenhaver)

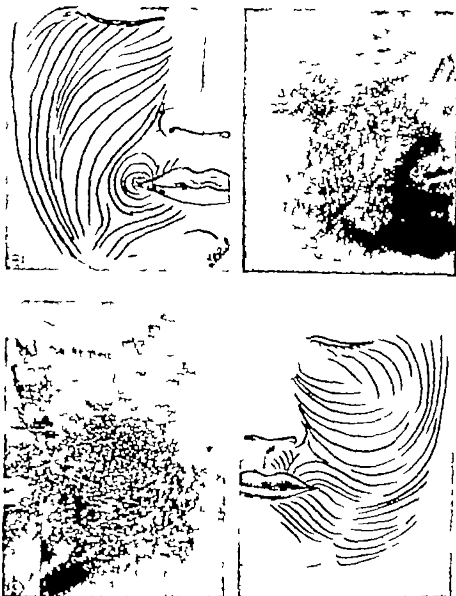


Fig. 151 Langer's lines on the forehead and face, demonstrated by Rubin, using a police printing device. A pad impregnated with a colorless chemical is pressed on the skin, leaving it upon the tops of the skin ridges and the depressed intervening valleys. Dry sensitized paper is gently applied to the skin to contact all the elevated skin ridges and is then removed. The chemical makes black lines on the paper along the points of contact. Rubin demonstrates that the folds or lines result from the combined and major muscle pull on the fibrous mesh in the skin. This is usually (normally) at right angles to the muscle pull, but not necessarily at right angles to the muscle fibers. This varies with individuals and may vary on two sides of the same person, as the author demonstrates in Figure 153 *a*. The "frown lines" in the center of the forehead vary with the location and the strength of the corrugator muscles as related to the frontalis. The fiber mesh in the scalp is normally distributed to produce the horizontal lines of the forehead upon contraction of the frontalis muscles.

a in the above figure pictures the "lines" resulting from the normal pull or traction of the quadratus group and the zygomaticus muscles of expression *b* a quite different line distribution because of the predominant influence or traction of the quadratus labii superioris and the zygomaticus muscles. (Photographs by courtesy of Dr L. R. Rubin.)

splits distinctly is more elastic when cut across (or transverse) the rows of splits or Langer s lines than one cut along these lines. Skin that splits in confusion is more uniformly elastic.

The skin has a small but perfect elasticity before it is stretched The elasticity becomes greater when the fibers themselves are lengthened by greater stretching or expansion



Fig. 152. Langer's lines after shifting the normal position of the covering skin. Author's tracings with the device described above. a New distribution of lines after repeated multiple excision of an infra-orbital and cheek nevus. The skin in the infra-orbital and temporal areas has been advanced from the mandibular area. b Split skin graft replacing a burn scar of the right upper lip The divided arrangement of the fiber mesh in this graft is apparent, as are the normal lines in the nasolabial fold at the angle of the mouth below the graft.

Retraction depends upon this elasticity The fibers may return to their original length and the net to its original arrangement. *This re turn of the net must depend upon some intermediary substance which is lost or altered by the process of tanning burning radiation* and so forth. A return of fiber stretching in leather can be accomplished only by cross stretching.

Simon (1873), Burchard (1903), Mussbaum (1923), and Co- (1941) reported various researches confirming the essentials of Langer findings.



Fig. 153. Congenital abnormal Langer's lines. *a*, This child has practically normal lines across the left forehead. The lines on the right side curve upward and mesially because of the location and abnormal traction of the right corrugator muscle. The resultant traction of the action of this and the frontalis muscle is predominated by the corrugator.

Marked "frown lines" result from this distribution of the corrugator muscle and may be corrected only by chemical palsy of this muscle or, better, its excision.

b, Langer's lines resulting from marked traction of the corrugator muscles. These muscles, inserted higher than normal, influence but do not predominate in determining the traction or pull on the fiber mesh in the scalp.

Davis and Kitlowski studied the retraction of excised skin with the natural conclusion that it is greater in full thickness than in split skin.

Operations of many types upon the lips must frequently demand incision across rather than parallel with Langer's lines. The resultant scar in either case is acceptable when proper detail in the closure is followed. Figures 235, 237, 240 illustrate these results.

Z PLASTIC OPERATION

This is one of the most useful and satisfactory plastic procedures It should have *first consideration* in planning the correction of scar contractures and misplaced tissue anywhere on the body surfaces The end result relaxes the contraction and changes the lines of "scar pull" to prevent limitation of movement of flexor surfaces It is often a proper substitution for flap operations It furnishes an equally good, and often a better, end result in a much shorter period of time and with less surgical effort.

Davis reviewed the literature of this consideration in 1931 He pointed out to the profession in an excellent article the rationale some of the useful applications and the technic of the Z plastic procedure He stated that "the utilization of such tissue (scar flaps) for the relaxation of scar contraction is not generally understood although the Z type of incision by which it is accomplished is an old procedure."

Davis and Kitlowski presented another excellent discussion of the use of Z plastic for the relief of scar contraction in 1939 They discussed a long, satisfactory personal experience and reviewed Limberg's papers, which clearly discuss the theory and practice of the procedure They state that "the Z incision is now well known and the method is frequently used by surgeons who are accustomed to dealing with scar contractures We find that there are many who do not understand the principle of the procedure at all, or realize its usefulness "

Some of the author s purposes and method of using Z plastic flaps and technic of multiple excision differ markedly from those described originally and commonly practiced

The Z type of incision and flap formation described for the relaxation of scar contracture is an old procedure which has enjoyed little of the thoughtful consideration and actual application to which it is entitled. It was first used by Denonvilliers in 1856 for the correction of an ectropion of the lower eyelid. It was used by his contemporaries, such as Szymanowski, then apparently lost sight of for years and rediscovered frequently since Piéchaud described the procedure for the relief of axillary and other contractures in 1896 Berry and Legg described its use for correction of misplaced tissue along scar in the lip, Morestin used multiple Z flaps for correction of flexor scar contraction of the fingers Pieri for deepening the commissures of the fingers in burned hands Davis for scar contractures of the face and neck; Babcock for finger webs, and Steindler for webs in the hands

The procedure as originally and subsequently described depends upon the shifting of scar infiltrated soft parts bordering the contracture to lengthen the line in which tension or "pull" occurs This is in contrast to the excision of this scar and the introduction of new tissue as generally practiced.

It is the author's purpose to call attention again to the value of this procedure and to illustrate a few of its many applications in the correction of disabilities resulting from scar and contracture He wishes to

emphasize that it is a procedure of choice in the correction of such disabilities anywhere on the body surface and that it should have first consideration along with two other procedures in the correction of surface functional and cosmetic disabilities of the face trunk and extremities

He wishes further to describe again a different use for the Z procedure which combined with multiple excision permits the complete substitution of normal for pigmented or other pathologic tissue without consequent distortion of eyelids nose or angles of the mouth or ears—in other words an end result which approaches the normal and cannot be accomplished in any other way

This incision makes possible the transfer of pathological tissue from an area where multiple excision would create a pull or traction producing distortion of normal features such as eyelids, alae of the nose angle of the mouth and so forth or undesirable scar about a joint. It is exchanged for good skin which may be advanced along lines that produce no distortion

This is particularly valuable in the infra-orbital area and on the upper lip where it is essential to leave the philtrum and angles of the mouth unchanged The method is not useful in the *upper infra-orbital* area in the male because of the introduction of hair bearing skin Abnormal skin of this area is better eliminated by the introduction of an interpolated temporal flap or a graft if the temporal skin is pathological

Indications. (1) Scar contractures anywhere (2) tissues misplaced and healed "out of line" (lips eyelids eyebrows angles of mouth neck wrists fingers and so forth) (3) transfer of pathologic tissue to a point where it can be multiply excised" without deformity, introduction of normal skin for subsequent excisions (Figs 239 242)

Time of Operation. "Time is the great healer" The changes and improvements occurring during the period of complete organization and relaxation assisted by local therapy (massage heat light and so on) often remove the necessity for any surgical interference The blood supply and surface organization are so precarious that the early shifting of tissues often results disastrously A minimal period of *three months* should elapse between the injury and the repair

Thick (Deep and Wide) Scar Masses. If these are unsuitable for the repair because of density and precarious blood supply they are removed between elliptical incisions The repair may proceed if the surrounding tissue is sufficiently relaxed to permit adequate shifting of the flaps Otherwise the incision is closed and the area allowed to heal

Length and Angles. The length of the component arms of the Z should be equal. The actual length depends on the area involved and the character of the tissue (Fig 154)

The angles formed by the arms and the central member should be equal for the usual case but they may be unequal if this is desirable The angles increase about 15 degrees when cut Factors which limit the use of flaps to those resulting from angles ranging from 30 to 60 degrees are (1) thickness of flaps which are viable (2) location and

size of contracture If the angles are made unequal, the [illegible] made as low as 20 degrees

The difference between the length of a line *CD* (Fig. 154 upper *left*) connecting the distal ends of the arms of the Z and the length of the center member *AB* gives the approximate amount of relaxation obtained $CD = 2\frac{5}{8}$ inches (6 6 cm), $AB = 1\frac{1}{4}$ inches (3.3 cm) The difference $1\frac{1}{8}$ inches (2 8 cm) = relaxation

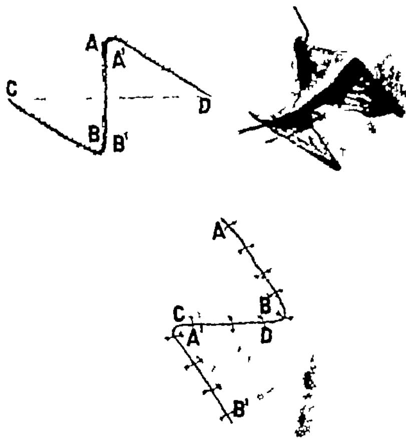


Fig. 154 *Upper left* Outline of Z flaps with a vertical [illegible] letters and numbers on the face of the drawing and [illegible] *right* Transposition of dissected flaps. *Lower* Approximation [illegible] central member becomes horizontal.

The greater the angle formed by the [illegible] ber of the Z, the greater the distance *CD* [illegible] being a constant regardless of the degree of [illegible] tween *CD* and *AB* increases with the angle. The [illegible] greater the relaxation obtained, and vice versa. T[illegible] the two lines becomes so great above 130 degrees [illegible] cannot be transposed. If the angle is less [illegible] of the central member of the Z (*AB* [illegible] 154 [illegible] greater than the line *CD* (Fig. 154 *upper left* [illegible] be transposed. The change in the position of [illegible] *C* and *D* makes clear the transposition which [illegible]



Fig. 155 Burn scar contraction of the neck, Z Plastic. *a*, Incision lines. *b*, skin opening after incision, demonstrating degree of contraction. *c*, reposition of the triangular flaps.



Fig. 158 *a* and *b* Scar contracture in the median line of the neck distorting the neck and chin line and partially fixing the head *c* Z flaps with unequal angles *d* result of Z plastic procedure.

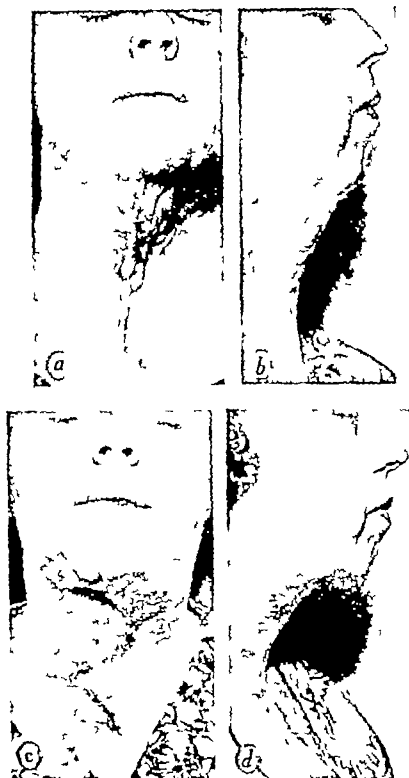


Fig. 158 *a* and *b* Scar contracture in the median line of the neck distorting the neck and chin line and partially fixing the head *c* Z flaps with unequal angles *d* result of Z plastic procedure.

A combination or modification of both incisions is occasionally desirable but generally these incisions allow the proper line of tension without deformity of the lid, ala or angle of the mouth. Management with these incisions is described in detail under Meloplasty (p. 298).

3. *Undercut the defective and surrounding normal skin to an extent* permitting maximal removal of defective tissue. *Do not undercut the opposing normal skin if its stretching produces distortions* of eyelids, nose or mouth which will not be corrected.
4. Excise the maximal amount of defect permitting closure without undue tension. This may be determined by stretching the normal bordering skin toward the lesion and overlapping it with the dissected defect.



Fig. 159. Multiple excisions. *a*. The dotted lines bound a pinkish-red nevus on the face and neck. *b*. result of four excisions; removal of pigmented skin from the borders of a peri-auricular incision.

5. Obtain total hemostasis.
6. Effect ordinary approximation.

Morestin Davis Technic. This, as well as the following case, is presented to illustrate the technical procedure originated by Morestin and advocated here by Staige Davis, and its cosmetic result. These were among the author's early efforts with this principle of repair. He regrets that the photographic records of this period are not available. Figure 160 *a* presents Stage 5 of this procedure. The patient was operated on twenty two years ago.

Case I. A female infant aged 7 months presented a port wine nevus of the right face extending from the zygoma downward in an irregular line to 1 inch (5 cm) above the mandible, to the midline of the upper lip and laterally to include two-thirds of the right face.

PROCEDURE. Stage 1. A myrtle leaf incision was made from the top to the bottom of the m n m with elevation of the involved skin on both sides of th m narg

There was an excision 1½ inches (3 75 cm.) wide. The ends were approximated with strong traction.

Stage 2. After an interval of eight months an excision ¾ inch (2 cm) wide was made.

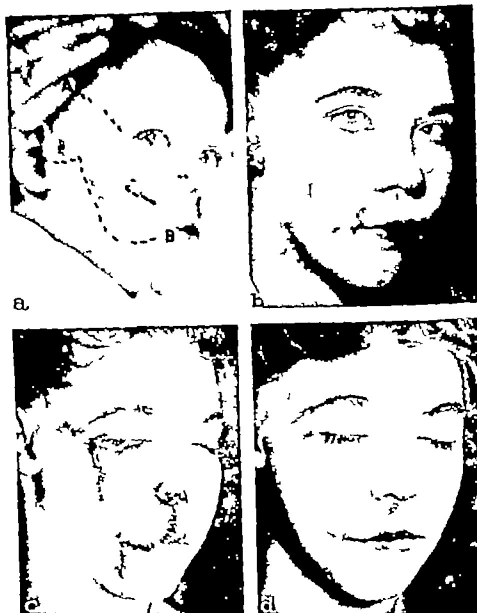


Fig. 160 Multiple excision, Morestin Davis technic. *a* The fifth stage of excision of a nevus extending from the zygoma to 1 inch (2.5 cm.) above the mandible, and from the angle of the mouth laterally to involve two thirds of the cheek. Note the scar of the incision along the line *AB* *b* Condition after twelve and one half years *c* and *d* stage 7 excision of cheek remnant and the lip nevus. The repair was completed two years later

Stage 3 After an interval of nine months an incision was made from the zygoma to the angle of the mouth (Fig. 160, *a*, *b*) A width of 1 inch (2.5 cm.) of the lesion was excised after upward mesial traction

Stages 4 and 5 After an interval of seventeen months and a further interval of

one year the same type of excision as pictured in Figure 160 *a* was continued. The result is presented in Figure 160, *b*

Stage 6. There was an interval of twelve and one half years the patient was not seen during this period. Meanwhile, the author no longer practiced this technic. The bordering skin was freely elevated to permit maximum advancement and excision. The scar below the eye was excised and sutured. The external canthus was repositioned. The normal bordering skin was advanced into the upper lip.

Stage 7 After an interval of eighteen months the normal skin was further advanced mesially in the upper lip and the old scar adjusted (Fig. 160, *c d*)

Stage 8. After an interval of two years the balance of the lesion in the upper lip was excised

This is a satisfactory result for the type of procedure, but the possible cosmetic result is spoiled by the scar running down the cheek. Further the desired result permits much simpler accomplishment

Case II The patient was a female infant, aged three months, with a benign, hairy melanoma (Fig. 161 *a*)

This patient's surgery was begun sixteen years ago before the author realized that the principle presented by Morestin had great possibilities, but that the described technical procedure is a clinical mistake. It defeats the discharge of much of the surgeon's responsibility the cosmetic result is much poorer than can be accomplished, and the procedures required are much in excess of those described and illustrated elsewhere in the text.

PROCEDURE This is the type of patient whose parents pursue a plan of procedure periodically *Consequently there are long intervals in its consummation*. This required ten stages of procedure for its accomplishment. These are apparent in the results of certain of these stages presented in Figure 161

The entire nevus could have been eliminated and a much better cosmetic result accomplished in four stages of the procedure discussed under Meloplasty (p 341)

Morestin repeated this procedure at intervals of a few days. This is impossible despite the fact that the surrounding skin relaxes rapidly if the dissection has been free and the removal maximal Two months is the earliest that relaxation adequate to justify the next procedure occurs This results from daily manipulation and massage

The possibility of the use of an interpolated flap multiple excision or a Z, *or a combination of them determines a "choice of procedure"* in planning and effecting the reconstruction. This choice is made against the universally popularized and accepted use of tubed pedicled flaps, free grafts and rotated forehead flaps in surface repair The latter properly constitute "procedures of necessity" in many cases and should be recognized as such as compared to those of "choice"

Some 5000 years elapsed from the time of the first record of rotated flaps before their value in surface repair was generally recognized standardized and their use popularized The art of free grafting was lost for six centuries The use of grafts on a large scale has been standardized and popularized in the last quarter of a century Interpolated flaps from the border of a defect were successfully utilized *for many years before World War I and the popularization of pedicled flaps and free grafts* has almost eliminated the interpolated flap from the planning of repair

The Z plastic procedure is only an infant in this group of procedures

it is only ninety years old. Its use in the relief of scar contraction in various locations and manners is a mere twenty years old. Its value in the sequence of well-planned procedure is not yet fully appreciated and practiced. It is one of the most valuable single procedures available to the surgeon



Fig. 161. Benign hairy melanoma multiple excision, Morestin Davis technic. This patient's parents followed the original plan of procedure periodically This accounts for the long intervals apparent in the photographs. The original is taken at the age of 3 months and the last at the age of 16 years. See Case II (p. 232)

The author's purpose is manifold. He is concerned with the dual quality of the end results which have characterized the modern plastic repair of the last twenty five years and with the hope that these considerations will alter much of our planning and add materially to our art and finesse

ANGIOMAS: VASCULAR AND LYMPHATIC

An angioma is "a true neoplastic process involving vascular and lymphatic tissue" (Ewing) It is congenital, originating in embryonic sequestration of mesodermal tissues. Such tumors grow in the same manner by projecting buds of endothelial tissue which canalize and connect with the original vessel They have no relation to previously formed vessels such as occur in varices.

They have only one afferent and efferent vessel Spontaneous regression results from physiological sclerosis of these vessels Both the vascular and lymphatic types have similarities in their response to treatment.

Hemangiomas are the largest *single group of tumors occurring in* childhood They occur more frequently in the female (65 per cent) Watson and McCarthy reviewed 1056 cases in which the locations follow

Head	52 per cent
Neck	4 per cent
Trunk	23 per cent
Extremities	19 per cent
Genitalia	2 per cent

The head and neck are one seventh of the entire body More than one half (56 per cent) occur here in this series.

Clinical Pathological Classification

Hemangioma

Naevus Vinosus (Port Wine Stain) This is a diffuse telangiectasis of dermal vessels lined with flat, *adult* endothelium The lesion does not blanch on compression.

Capillary Hemangioma. This is a new growth of capillary vessels with delicate stroma and well-differentiated endothelium of the *embryonic* type

Cavernous Hemangioma. In this form there are markedly dilated vessels in and beneath the skin presenting numerous local spherical dilatations or blisters some of which coalesce to form lakes or sinuses. They are commonly mixed with the capillary type. They may form arteriovenous connections in the neck and elsewhere with resultant fatal hemorrhage

Cutaneous Arterial Spider The following is quoted from the careful investigation and excellent description of Dean

> The structure of the spider is unique. The main vessel is an artery larger than those arising in the subcutis. It courses through a coil and tortuous passage almost to the surface of the skin where it breaks up into a multitude of branches which spread out immediately below but parallel to the surface In its gross aspects the main vessel mimics the spiral artery of the endometrium. In addition to the pulsation a whip action imparts a surprising impact over the small central spot particularly when the latter is elevated above the surrounding skin. Main structure suggests

hyperplasia and hypertrophy being angiomatous in nature while the radicals may be true telangiectases. An attempt to answer the question whether hypertrophy alone or benign neoplasia can rightly be said to constitute the avocative force behind the spider would carry us beyond the scope of this paper

Pattern of distribution is peculiar in characteristic, with some variations in the several groups The face and neck are affected preponderantly The arms and upper portion of the body less frequently while only rarely do the lesions appear below the level of the midriff. The reason for this peculiar distribution is not known A possible factor may be the variation of tone and the small vessels of the skin Spiders are uncommon where vasoconstriction is strong, plentiful where it is relaxed. Thus a fresh area is implicated in most instances The fact that plantar erythema is much rarer than that of palms also fits with such an explanation The mucous surfaces of the body have been explored too little to permit conclusions Most of the lesions occurring in the mucosa have been found in the mouth nose pharynx and a few in the rectum and genito-urinary tract.

Spiders may occur in the following classes of persons (1) subjects with liver disease (2) pregnant women (3) persons with deficiency disease caused by lack of the B complex vitamins and (4) normal persons

Angioblastic or Hypertrophic Hemangioma. These are noncompressible solid, elevated purplish red masses occurring chiefly in the skin

Racemose Hemangioma. These are rare pulsating, tortuous capillaries and arterioles which have a tendency to recur after treatment.

Metastasizing Hemangioma. Watson and McCarthy find four such cases in the literature They report nine of the racemose variety in 10 000 cases.

Lymphangioma

Simple Lymphangioma. This is an uncommon disease entity bordering on simple lymphangiectasia. It has scattered, thin-walled, superficial channels forming circumscribed wartlike lesions with little tendency to growth.

Cavernous Lymphangioma. This is composed of dilated sinuses containing lymph. They are lined with flat endothelium which may be present in several layers in active cases The stroma varies It may contain lymphoid or smooth muscle tissue arising from mesoderm fat fibromatous elements and endothelial buds invading the surrounding muscle and fat.

The lesion usually involves the skin and/or the subcutaneous tissue. It may involve the oral mucosa or grow between the muscle septa in the neck. The superficial lesions are brownish red wartlike papules. The deeper lesions are compressible, doughy masses with no changes in the skin It produces macroglossia macrocheilia and macromelia It also occurs in the mesenteric, retroperitoneal areas and the extremities

Cellular or Hypertrophic Lymphangioma. This is an uncommon mass that grows slowly It is a more active type of the cavernous lesion with a minimum of sinuses and an abundance of proliferating endothelium.

Diffuse Systemic Lymphangioma. *This is a slow-growing process* which generally involves an entire extremity producing an appearance of hypertrophy and a feeling of doughy consistency The channels frequently contain blood and simulate a cavernous hemangioma, but its behavior is that of the lymphatic lesion

Cystic Hygroma. This is a distinct disease entity developing in lymphatic tissue. It is generally multilocular thin walled and compressible. It is lined with endothelium contains serous fluid and is readily transilluminated It is generally present in the neck at birth and grows rapidly The growth often extends from the neck into the axilla or the mediastinum.

The rapidity of growth is credited to the fact that hygromas originate from the same primitive centers from which the lymphatic system develops. Two such sacs are adjacent to the internal jugular veins in the neck, in the lumbar retroperitoneal area, and in the iliac area. These are the sites in which they are usually found. Goetsch demonstrated that solid endothelial sprouts invade surrounding tissues encircle vital structures secrete lymph and canalize back to their origin.

Treatment of Angiomas

The frequency of these angiomas together with pigmented nevi, the scars from burns, trauma, and so forth on exposed surfaces produces a volume and type of responsibility which in the majority of cases, has not yet been properly managed.

The time of this management is determined by the histopathology of the initial and the later untreated lesion This is, further largely influenced by the attitude of the parents and later by the psychic effect of exposed lesions upon the patient. An untreated or badly managed lesion materially affects the mental and social development of the person.

Most of these lesions create no functional disturbance or menace to health *they are purely cosmetic* The deep pathology—involvement of the ears orbit and lids, nose lips, cheeks tongue neck and extremities—presents a different problem of correction but does not relieve the surgeon from his dual responsibility to produce both a functional and desirable cosmetic result.

The main thought and effort through many years has been the destruction and elimination of the lesion without proper consideration of the later effects of the treatment upon the skin, the developing bone the effect of contracting scar and so forth. The numerous patients appearing later with mottled, atrophied skin ectropion, facial asymmetry maldevelopment of long bones and so on attest to the misconception of several treatments. The result in many instances is an exchange of one cosmetic disability for another plus developmental retardation or elimination (see Figs 235 239) The surgery proposed

and practiced in many cases eliminates interference with structural development, but frequently results in marked cosmetic objections.

The several agents used have the common purpose of sclerosing and obliterating the afferent vessel and those constituting the lesion itself. Some of these have a limited or perhaps, no proper use whatever, as usually employed A combination of two or three of these in an indicated sequence is frequently useful.

Carbon Dioxide Snow This is applied as a solid block held in gauze by the fingers not to exceed ten seconds. Superficial ulceration follows freezing for twelve seconds A safe interval between applications is two months. Dermatologists use it widely for small isolated and for superficial capillary lesions. It is not efficient as a sclerosing agent, and its action is too superficial for value in cavernous lesions The author feels that other treatments are safer and produce more desirable results

Sodium Morrhuate. This is used in a 5 per cent solution of varying dosage by numerous doctors. The amount varies from 0 25 to 3 cc. depending on the size and location of the lesion The author has had satisfactory results from one to two minims in the conjunctiva lids and lips injected at intervals of six to eight weeks. If blood can be aspirated the larger dose is injected into the mass and immediate compression maintained for several minutes This is repeated at weekly intervals in large cavernous lesions. If growth is not inhibited after several injections, other methods should be adopted.

This solution causes thrombosis sclerosis and ultimate atrophy The small vessels and abundant stroma in capillary lesions preclude good routine results. Other treatments are preferable here.

Electrosurgery This produces scar that demands ultimate surgical correction *Interstitial coagulation* in expert hands, has value in the case that does not respond satisfactorily to radiation and which is not to be dealt with surgically A fine electrosurgical needle is inserted into the mass at intervals of 3 cm The coagulating current is used until the area begins to blanch—about five seconds The current should not cause more than mild coagulation Slough follows a greater degree

Ligation. Ligation of the afferent vessels and some of the bordering mass followed by the sclerosing solution or radiation frequently simplifies and improves the quality of surgical management in gross lesions (Figs. 318 409 *a*)

Radiation. This treatment in any of its several forms should be instituted as early as possible because the radiosensitivity of the endothelial cells lining the vascular tumor decreases in direct proportion to age They are more sensitive in the embryonic and early period of life It is the author's conviction that radiation should never be used in amounts that create late atrophy and scarring unless the surgical removal of this cosmetic disability is included in the plan of management

All types of irradiation produce sclerosis of the stroma and obliterative endarteritis This, obviously, depends upon the filtration used and the dosage. Some excellent cosmetic results are produced by

platinum filtration to remove the beta rays, aluminum foil and rubber to remove secondary rays from the primary filter a total dosage not exceeding 300 r and preferably an initial dosage of about 150 r with a time interval of three to six months until the final treatment.

The result obtained depends upon the radiosensitivity of the cells in the mass its size and the supporting connective tissue. By this sensitivity is meant the degree and time of response to radiation

Cutler Busche and Cantril define three types of sensitivity inherent, transient, and acquired. Every cell has an inherent sensitivity which probably depends upon its usual life history Hemangioma is fairly sensitive to radiation. It ranks about third among the cells

Ward and Covington define transient sensitivity as the response during certain phases of the cell's life history It is most sensitive during mytosis and less so as it grows older

Acquired sensitivity means alteration in the original state It never increases during cell life but may be decreased by several factors. The most important is decreased blood supply owing to obliterative endarteritis and sclerosis following previous radiation. Age is an important factor A hemangioma is most radiosensitive during the early months of life.

Cavernous hemangioma does not, as a rule respond to radiation so readily as the capillary type ordinarily found in the skin. The latter is the most radiosensitive of all hemangiomas. The only difference between the capillary and cavernous type is the size of the blood spaces.

Port wine stain (naevus vinosus) does not respond to radiation.

The various types of radiation treatment have able sponsors who report good cosmetic results Our observation in many instances has been quite the contrary

Ward and Covington believe that external irradiation is the best of all sclerosing agents because the rays diffuse equally throughout the growth. They believe it possible to give the maximum safe irradiation externally without resort to radium needles or radon seeds interstitially

Brown and Byers, on the contrary advocate the interstitial use of radon seeds The content varies from 0.25 to 0.5 millicurie, depending upon the location and size of the pathology The total dosage is one seed per cubic centimeter deposited beneath the corium.

Figi, after a large and varied experience, favors radium electrocoagulation, excision and sclerosing chemicals. Their relative value depends upon the type of lesion, age of the patient and previous treatment. The late results of radiation in cases presenting early pleasing appearance causes him to advocate the use of radon seeds of 0.25 to 0.3 millicurie each placed 1 cm. apart.

Contact x ray impresses the author as the best type of radiation for surface lesions and those combined with subcutaneous involvement. The type of apparatus, the depth of penetration the various parts limiting the radiation to the desired area, the few seconds required for the

desired dosage and so forth, make possible the treatment of infants and young children without apprehension Portmann reports a group of different types of lesions in various localities treated with excellent results

The author utilizes interstitial radon seeds to sclerose gross lesions and prepare the skin for use if indicated, in subsequent surgical repair (Figs 408, 409 a pp 599 601) The same preparation is accom plished with sodium morrhuate in similar smaller lesions when the pathological tissue is to be excised This with ligation of the efferent and afferent vessels, is particularly useful in gross lesions in the lips (Fig. 247 p 369)

Surgical Excision. Both the original lesion and the end results of treat ment present a similar problem. The latter frequently presents other demands as the result of scar contraction, sloughs with functional dis-turbances asymmetries resulting from retarded bone or cartilage de velopment as the result of early radiation, repeated applications of carbon dioxide snow and so forth

The cosmetic result of the *surgery commonly practiced* fails largely to accomplish the proper purpose of the surgeon and meet his responsi bility to the patient Skin grafts of any type some types of flaps trans-mitted on a pedicle and scar in conspicuous areas have no proper place in the repair of exposed surfaces particularly the face Fine linear scars in one or all of three least conspicuous locations permit the removal of the most extensive lesions and covering with normal bordering skin, if any is available on the face temporal region and the neck (Figs. 239 240 pp 355 357)

Essential lines of traction, the elastic pull of the transferred skin, permit the use of one of Langer's constant lines between the nose and cheek and about the outer angle of the lips These lines are otherwise disregarded entirely in the author's multiple excision and Z flaps in this procedure.

Multiple excisions, as originally described and later advocated, call attention to an essential possibility but do not permit the full accom-plishment of a desired purpose (see pp 228 231)

End Results of Radiation and Excess Sclerosing Chemical

1 Some degree of *sclerosis* of tissue occurs after all adequate doses of radiation It produces a poor cosmetic result when the scar is thick and contracted It is the most common late effect.

2 Fvery case of marked sclerosis has some degree of *skin atrophy* Excess irradiation and poor filtration are the common causes Invasion of the skin by the proliferative vessels has already disturbed its normal structure Sclerosis of these vessels completes this cause

3 Increased *pigmentation* occurs to some degree immediately after radiation. Its character depends upon the type of skin

4 *Residual tumor* is frequent. It is present more often in the treated cavernous and mixed type than in the capillary variety (Figs. 235 239

247) The distribution of the small residuals in areas of skin atrophy produces a distressing cosmetic result.

5 *Telangiectasis* is probably proportional to the degree of sclerosis. It is the author's opinion that the *sclerosis of proximal ends of these capillaries forms* "bottle necks" for return flow increases the pressure in a congenitally deficient capillary wall and results in its visible dilatation. This is an occasional occurrence in the apparently normal skin bordering a *hemangioma which has been replaced by multiple excision.* The skin in these cases is sutured under maximum tension in each step until the final one The invisible skin capillary is comparable to a stretched rubber band—its length increases and its cross section decreases The smaller lumen increases the pressure and dilates the wall. Blebs—spherical dilatations—are sometimes seen on the terminal ends of these capillaries. These repeated observations convince one of bordering, invisible congenital vascular defects other than those resulting from the growth of projecting endothelial buds

Popoff demonstrates and defines the following

(*a*) No internal elastic lamina

(*b*) Longitudinal inner and outer circular muscle fibers. These are indistinct. Among these muscle cells or fibers are large, clear epithelioid like cells with oval or globular nuclei. Ramifying among these cells are anastomosing cells with elongated nuclei and transparent cytoplasm *without myofibrils*

(*c*) The outer zone of the anastomosis contains numerous nonmedullated nerves

(*d*) The entire anastomosis is surrounded by coarse, lamellated *collagenous tissue containing the collecting veins The primary ones* have thin walls and no muscular cells.

Wright states

> *The capillaries can actively modify their own caliber and respond to nervous, hormonal and other chemical and physical stimuli. There is still great uncertainty about the identity of the contractile tissue in the capillary wall. It has been suggested that the branch cells of Rouget, which form an incomplete outer coat to the capillaries, may represent modified muscle fibres. The evidence suggests, however that active variations in capillary caliber are due to alterations in the state of the lining endothelial cells themselves when these swell the capillary lumen is reduced.*
>
> *Sympathetic fibres pass to the capillary wall and probably transmit tonic vasoconstrictor impulses from the vasomotor center In the main, however capillary tone is controlled by local physical and chemical agencies.*

They can alter their caliber independently of the state of the arterioles or venules

There must be two types of capillaries concerned in these surface lesions Not only do the projected endothelial buds coalesce in the stroma and form blebs or lakes to become cavernous, but they also adhere and the mass canalizes to produce a capillary type The author believes more than that. *The invisible vessels in bordering skin from* ¼ inch (1 cm) to 2¼ or 3 inches (7 5 cm) away from the lesion

dilate to form telangiectasis and sometimes blebs (see Figs. 247, 249, pp 369 374) These dilated capillaries may become numerous under repeated tension. These vessels must have some of the congenital disability, but, to a less degree, of the dilated capillaries forming the visible lesion It requires only an increase in pressure to dilate their walls and make groups of them increasingly visible

One also sees them variously distributed about the alae or on the alae and radiating on the cheek, also, isolated, circular lesions about the knees, and so forth These may be deficiencies in the capillary walls, since they occur after adolescence.

6 Irradiation of scalp hemangioma results in loss of hair which may return in several months, but occasionally results in permanent *alopecia*

7 Radiation ulcers may continue chronically in cases of excessive dosage poor filtration and in markedly radiosensitive skin

8 *Arrested Bone Development and Epiphyseal Injury* The frequent cases coming to the author s attention through a period of years which present marked facial asymmetry accompanying bad results of the radiation treatment of hemangioma during the crucial eight years of facial bone development force him to believe that the treatment deterred or suspended the development.

He recognizes that asymmetries are not uncommon throughout the entire body that they occur fairly frequently in the face with no visible cause and that they result from distrophies (muscular) and so forth The bones in the cases under consideration however have failed in proper development only in the area treated. He has yet to see an early treated hemangioma on one side of a face with normal bony support and an asymmetry on the other side which is not involved with vascular lesion

He has not seen a case of epiphyseal damage with altered growth but recognizes this possibility

It is the author's opinion that cases not readily and definitely managed by *small* doses of contact ray or sclerosing chemicals are best managed surgically The type of this surgery has been indicated here and will be discussed fully later The objection that the time and expense involved are too great as compared to other treatments should not influence the surgeon. It is his obligation to consider the mental social and economic future of his patient through a long period of years and produce the best possible end result.

FOREIGN BODIES. REMOVAL

The old adage, "When a bullet ceases to move, it ceases to do damage," is not literally true when one considers the various types of missiles which may become embedded in the body (bullets jagged metal strips splinters of metal wood glass, cinders and so forth) and their final locations.

Those which abrade or penetrate the walls of vessels (Fig 162)



Fig. 162. Lead bullet of large caliber in the median border of the foramen lacerum. The bullet was wedged against the internal carotid artery. It was removed through the tract in the maxilla under local anesthesia 10 days after it had been received. *Upper* Anteroposterior view *lower* lateral view

and nerves, or the *spinal column* to injure the spinal cord create an emergency which must be dealt with immediately Those which have created and are maintaining suppuration must be removed as soon as the patient s condition permits. Those which fulfil the statement of the axiom may be removed at the discretion of the surgeon.

Remember a second adage A wound on the surface caused by the entrance of a bullet does not mean, necessarily that the bullet has remained in that vicinity" The location and removal of the roentgenologically demonstrable foreign body frequently require the greatest cooperation and skill of the surgeon and the roentgenologist.

Localization. The roentgenologic methods used for localization are (1) the two-wire double-shift method of Strohl (2) triangulation single-tube shift (3) use of the localizing profundoscope (Reed Black) and (4) intermittent roentgenoscopy using the bonnet roentgenoscope.

These methods enable the roentgenologist to measure accurately the distance from several surface points to the embedded foreign body It would seem relatively simple for the surgeon to follow the roentgenologist s directions to the foreign body Vitally important structures frequently intervene necessitating an approach and procedure much more taxing to both collaborators than a direct one The roentgenologist frequently must direct the actual course of the surgeon to the foreign body despite its accurate mathematical localization. This requires of both more than the ordinary familiarity with orthodox topographical and sectional anatomy It demands sound judgment to accomplish removal without added disability to the patient

The skull is composed of so many bones which may be used as landmarks that the utilization of some of these methods of study readily accomplishes a satisfactory localization The neck presents greater difficulty but the application of these methods permits localization and removal without great hazard to the patient.

An excellent discussion of this subject by Reed and Black in an article from the Department of Roentgenology of the Army Medical School should be studied carefully

TRAUMATIC TATTOO

These tattoos are implantations of pigmented foreign bodies. They consist usually of dirt and cinders in accidents of transportation dirt and detritus in domestic accidents, and emery carbon and all sorts of detritus in industrial injuries. They may involve all layers of the skin and subcutaneous tissue, but the bulk of the material is frequently in the derma.

The nature and distribution of the foreign material largely determine the method of successful handling. This should be accomplished as early as possible and certainly before healing occurs

Meticulous scrubbing with a stiff brush has been the general practice for many years

The area and its borders should be carefully prepared and infiltrated with procaine (0.5 per cent) and epinephrine (1 2000)

The scrubbing should be moderately vigorous and supplemented with use of a spud or sharp-pointed instrument, if required. The field should be freely irrigated with normal saline and cleansed with ether A dressing of Furacin gauze for one or two days is followed with scarlet red gauze until healing is complete

Iverson has recently described an excellent procedure which is essential if the involvement of the derma and subcutaneous tissue is marked. It uncovers the subcutaneous involvement, which may then be removed by excision It offers the only useful management, other than surgery, if surface healing has occurred (Fig 163)

Ordinary sandpaper 0 and 00 is used as the abrasive It is cut in strips that will fit around a 3 inch gauze bandage A strip of adhesive,

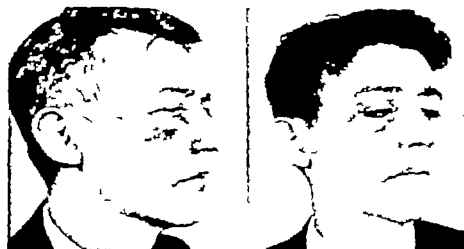


Fig. 163 Traumatic tattoo Iverson sandpaper procedure. See text (p. 243) (Courtesy of Dr P C. Iverson.)

1 inch wide and 3 inches long, is applied to the smooth surface of the paper which is then wrapped around the gauze bandage and held together by a free end of the adhesive Small strips are cut to wrap around curved instruments that will permit abrading small grooved surfaces, e g. the nasolabial and alar facial grooves and so forth This material is then wrapped and autoclaved

The surface is carefully prepared, the area infiltrated with procaine and the like and vigorously abraded. This is continued until bits of subcutaneous fat appear through small perforations in the derma, if this is required. The effort is supplemented with the use of a spud, and so on, as noted before Iverson states that larger areas of subcutaneous fat do not appear suddenly Profuse oozing is controlled with hot saline packs and adrenalin.

Particles of the grit and loose bits of foreign body are removed by copious saline irrigation

The area is dried. Three or four successive cotton sponge applica

tions of 10 per cent tannic acid followed by 10 per cent silver nitrate produce a protective eschar This is dusted with sterile talcum or sulfadiazine powder and covered with fine meshed gauze and fluffed gauze, and a pressure bandage is applied.

The tannic acid and silver nitrate produce cellular coagulation which removes bits of pigment that may have remained.

This dressing is removed in seventy two hours and the area treated as a fresh surgical area for three or four days. The healing is complete in approximately two weeks The color of the area gradually matches that of its surroundings

The ordinary professional tattoos with various inks are not amenable to this treatment. They are best managed by multiple excision.

LIGATIONS

Ligation of Common Carotid Artery above Omohyoid Muscle *Landmarks* Line of the artery anterior border of the sternomastoid muscle, cricoid cartilage

Incision An incision 3 inches (about 7.5 cm) long is made lying in the line of the artery, with its center at the level of the cricoid cartilage

Procedure Incise the skin, the superficial fascia and the platysma muscle (Fig. 164) Divide the deep fascia along the anterior border of the sternocleidomastoid muscle and open the connective tissue The upper border of the omohyoid muscle is here exposed either by direct incision or by following up the anterior border of the sternocleidomastoid. The sternocleidomastoid muscle is retracted downward and the omohyoid muscle downward at the point where it passes beneath the sternocleidomastoid. The common carotid artery is located as it passes the "carotid tubercle" Avoid or tie the sternomastoid artery and superior end of the middle thyroid veins. Incise the sheath carefully from the inner side to avoid the descendens hypoglossi nerve and the internal jugular vein Free the artery from its sheath in its entire circumference Pass the ligature from the internal jugular vein and vagus nerve

Collateral Circulation. Inferior thyroid with superior thyroid deep cervical with occipital, transverse cervical with occipital branches of two vertebrals with branches of two external carotids circle of Willis.

Ligation of External Carotid Artery below Digastric Muscle: *Landmarks* Sternocleidomastoid muscle the thyroid cartilage angle of the jaw

Incision. An incision is made from the level of the middle of the thyroid cartilage for a distance of 3 inches (about 7.5 cm) to a point near the angle of the jaw along the anterior border of the sternomastoid muscle (Fig. 165)

Procedure Incise the skin, superficial fascia, and platysma muscle. Divide and tie any veins in the line of incision Divide the deep fascia and expose the anterior border of the sternocleidomastoid muscle

Retract it outward. Find the posterior belly of the digastric muscle at the upper angle of the wound Locate the hypoglossal nerve crossing the external carotid artery below the origin of the occipital artery Locate the tip of the great cornu of the hyoid bone opposite which the lingual artery arises Expose the artery opposite the tip of the

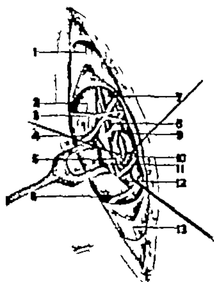


Fig. 164

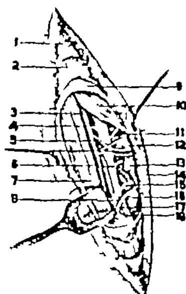


Fig. 165

Fig. 164 Dissection for common carotid artery (Bickham) *1* Platysma muscle; *2 sternocleidomastoid muscle 3 one of the transverse cervical nerves· 4 sterno*mastoid artery *5* nerves from the loop between the descendens hypoglossi and the descending cervical *6* communicating vein between the anterior and external jugular· *7* common carotid artery (sheath incised above the omohyoid muscle) *8* superior thyroid vein *9* sternothyroid muscle *10* inferior thyroid vein, *11* internal jugular vein *12* omohyoid muscle (retracted downward) *13* platysma muscle.

Fig. 165 Dissection for external carotid artery (Bickham) *1* Superficial fascia, *2* platysma muscle *3* internal jugular vein *4* occipital artery· *5* hypoglossal nerve *6* external carotid artery· *7* sternocleidomastoid muscle *8* internal carotid artery· *9 cervical fascia, 10 posterior belly of digastric muscle· 11 external maxillary* (facial) artery *12* hyoglossus muscle with lingual artery disappearing beneath it, *13* tip of great cornu of hyoid bone; *14* middle constrictor muscle *15* superior thyroid artery· *16* inferior constrictor muscles *17* superior thyroid vein *18* descendens hypoglossi nerve.

great cornu of the hyoid bone—avoid the superior thyroid facial and lingual veins Clear the sheath and pass the ligature between the superior thyroid and lingual branches of the external carotid artery guarding the descendens hypoglossi nerve in front and the superior laryngeal nerve passing behind the artery direct the needle from the internal carotid artery The superior thyroid, lingual external maxillary (facial) occipital and ascending pharyngeal arteries may be ligated through this same incision.

Collateral Circulation Same as for ligation of the common carotid artery above the omohyoid muscle

Ligation of Lingual Branch of External Carotid Artery, beneath Hyoglossus Muscle *Landmarks* Lower border of the inferior maxilla the facial artery crossing the inferior maxilla hyoid bone

Incision A curved incision is made beginning just below and external to the symphysis menti and ending just below and internal to the crossing of the facial artery over the inferior maxilla. The center of the incision is just above the great cornu of the hyoid bone

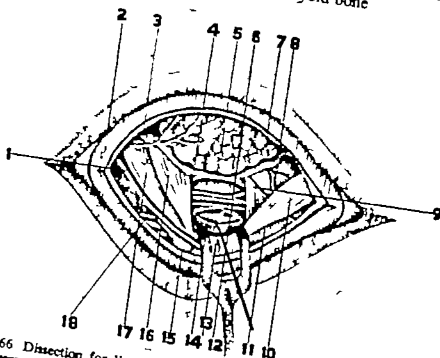


Fig. 166 Dissection for lingual branch of external carotid artery (Bickham) *1* Transverse cervical nerve *2* platysma muscle *3* tributary of temporomaxillary vein *4* deep cervical fascia under submaxillary gland *5* submaxillary gland *6* hypoglossal nerve *7* deep fascia *8* submental artery *9* tributary of anterior jugular vein, *10* anterior belly of digastric muscle *11* mylohyoid muscle *12* ranine vein (vena comitans of hypoglossal nerve) *13* omohyoid muscle *14* lingual artery seen through incision in hyoglossus muscle *15* thyrohyoid muscle *16* stylohyoid muscle *17* posterior belly of digastric muscle *18* superior laryngeal nerve and vessels.

Procedure Incise the skin platysma muscle, and deep fascia (Fig. 166) Avoid or ligate the tributaries of the facial anterior jugular or temporomaxillary veins. Incise the transverse cervical fascia over the submaxillary gland. Retract the gland upward over the margin of the lower jaw Incise transversely the deep cervical fascia which is exposed by lifting out the submaxillary gland identify the mylohyoid muscle in the anterior part of the wound Expose the two bellies of the digastric muscle and retract them downward at their point of attachment to the hyoid bone This renders the hyoglossus muscle more

prominent. Identify the hypoglossal nerve crossing its anterior aspect. The ranine vein (vena comitans of hypoglossal nerve) crosses just below and parallel to the nerve at about the level of the artery on the opposite side of the muscle Retract the hypoglossal nerve and ranine vein upward Divide the hyoglossus muscle transversely for ½ inch (about 1.3 cm.) just above and parallel with the hyoid bone. This incision is immediately over the artery which generally bulges into the opening or is easily reached. Trace the artery backward until the dorsales linguae branches are reached so that the ligature may be placed on their proximal side

Ligation of Facial Artery over Inferior Maxilla: *Landmarks* Anterior margin of the masseter muscle and the horizontal portion of the inferior maxilla

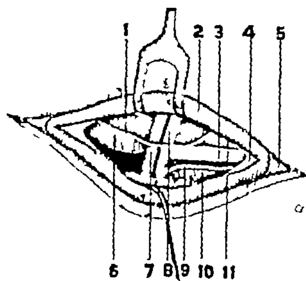


Fig. 167 Dissection for facial artery (Bickham) *1* Supramaxillary nerve' *2* platysma muscle' *3* inferior maxilla *4* deep cervical fascia, *5* superficial fascia *6* masseter muscle' *7* facial vein *8* facial artery' *9* submental artery' *10* mylohyoid muscle, *11* depressor anguli oris muscle.

Incision An incision is made about 1 inch (about 2 5 cm) in length parallel with and under the lower border of the jaw with its center at the anterior margin of the masseter muscle

Procedure Incise the skin superficial fascia platysma and deep fascia, exposing the artery (Fig. 167) The facial vein lies posterior to it. Avoid branches of the facial nerve

Ligation of Occipital Branch of External Carotid Artery, behind the Mastoid Process. *Landmarks* Mastoid process and external occipital protuberance.

Incision Begin at the tip of the mastoid process and extend toward the external occipital protuberance for a distance of about 2 inches (*about 5 cm*)

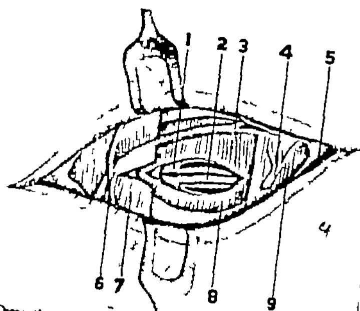


Fig. 168 Dissection for occipital branch of external carotid artery (Bickham) *1* Longissimus capitis (trachelomastoid) muscle *2* occipital artery and veins *3* posterior external jugular vein *4* greater occipital nerve *5* posterior cervical fascia *6* lesser occipital nerve *7* sternocleidomastoid muscle *8* splenius capitis muscle *9* trapezius muscle.

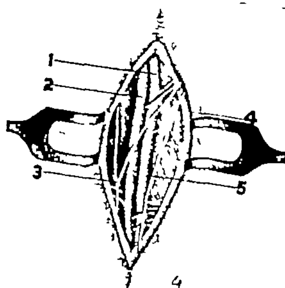


Fig. 169 Dissection for the temporal artery (Bickham) *1* Temporal artery with its anterior and posterior bifurcations and its middle temporal, transverse facial and anterior auricular branches *2* temporal vein *3* temporal branches of the auriculotemporal nerve, *4* temporal fascia *5* branch of the temporofacial division of the facial nerve.

prominent. Identify the hypoglossal nerve crossing its anterior aspect. The ranine vein (vena comitans of hypoglossal nerve) crosses just below and parallel to the nerve at about the level of the artery on the opposite side of the muscle. Retract the hypoglossal nerve and ranine vein upward. Divide the hyoglossus muscle transversely for ½ inch (about 1.3 cm.) just above and parallel with the hyoid bone. This incision is immediately over the artery which generally bulges into the opening or is easily reached. Trace the artery backward until the dorsales linguae branches are reached so that the ligature may be placed on their proximal side.

Ligation of Facial Artery over Inferior Maxilla: *Landmarks.* Anterior margin of the masseter muscle and the horizontal portion of the inferior maxilla.

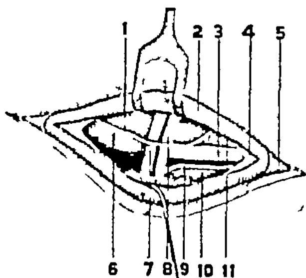


Fig. 167. Dissection for facial artery (Bickham). *1* Supramaxillary nerve platysma muscle. *3* inferior maxilla. *4* deep cervical fascia. *5* superficial fascia. *6* masseter muscle. *7* facial vein. *8* facial artery. *9* submental artery. *10* mylohyoid muscle. *11* depressor anguli oris muscle.

Incision. An incision is made about 1 inch (about 2.5 cm.) in length parallel with and under the lower border of the jaw with its center at the anterior margin of the masseter muscle.

Procedure. Incise the skin, superficial fascia, platysma and deep fascia, exposing the artery (Fig. 167). The facial vein lies posterior to it. Avoid branches of the facial nerve.

Ligation of Occipital Branch of External Carotid Artery, behind the Mastoid Process. *Landmarks.* Mastoid process and external occipital protuberance.

Incision. Begin at the tip of the mastoid process and extend toward the external occipital protuberance for a distance of about 2 inches (about 5 cm.).

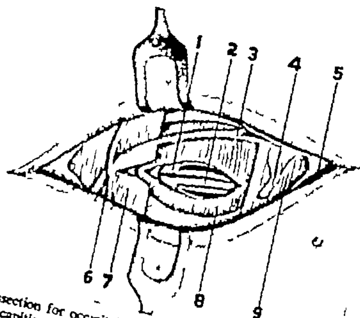


Fig. 168 Dissection for occipital branch of external carotid artery (Bickham) 1 Longissimus capitis (trachelomastoid) muscle· 2 occipital artery and veins· 3 posterior external jugular vein 4 greater occipital nerve 5 posterior cervical fascia 6 lesser occipital nerve· 7 sternocleidomastoid muscle 8 splenius capitis muscle· 9 trapezius muscle.

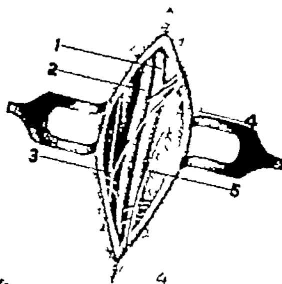


Fig. 169 Dissection for the temporal artery (Bickham) 1 Temporal artery with its anterior and posterior bifurcations and its middle temporal transverse facial and anterior auricular branches 2 temporal vein 3 temporal branches of the auriculotemporal nerve· 4 temporal fascia 5 branch of the temporofacial division of the facial nerve.

Procedure Incise the skin and the fascia (Fig 168) Divide the posterior half of the sternocleidomastoid muscle and its aponeurosis, the splenius capitus muscle and as much of the longissimus capitis (trachelomastoid) muscle as is in the field Relax the muscles by turning the head *to the side of the operation* and retract. The artery will be exposed deep down between the mastoid process and the transverse process of the atlas, resting on the obliquus capitis superior (superior oblique) and semispinalis capitis (complexus) muscles Separate it carefully from the accompanying veins, and ligate The lesser occipital nerve runs on the posterior surface of the sternocleidomastoid muscle near its posterior border and the great occipital nerve pierces the trapezius muscle near its outer border

Ligation of Temporal Artery, above Zygoma. *Landmarks* The zygoma tragus of ear condyle of jaw

Incision An incision is made about 1¼ inches (nearly 4 cm.) in length in the line of the artery with its center over the zygoma.

Procedure Incise the skin and parotid fascia exposing the artery as it crosses the zygoma (Fig 169) Avoid the branches of the facial and auriculotemporal nerves and the accompanying vein the last lies posteriorly

UNDESIRABLE PROCEDURES

Few if any of the operations described in texts for large partial or total lip reconstruction should ever be performed This radical statement is readily defended Practically all these operations contemplate the use of full thickness cheek flaps which are cut without regard for the muscles of expression about the mouth or for the blood and nerve supply The muscle included in these flaps atrophies in most instances and supplies only a scar filling which is without function. It is never necessary to cut into the musculature about the defect in order to effect a repair

Such operations as those of *Szymanowski* (Fig 170) are extremely destructive of function and cannot possibly produce a pleasing cosmetic result The procedure pictured in Figure 170 *A* for the reconstruction of both lips was never accomplished on a living patient The incisions outlining flaps *b* and *d* completely sever the blood and nerve supplies. The lateral incision to create the opening of the mouth between *b* and *d* leaves a narrow island of tissue to nourish the entire triangular flap *b* The end result, if such could be obtained would be a crippling functional and cosmetic disability

The procedure pictured in Figure 170 *B* is possible of attainment from the standpoint of blood supply inasmuch as the proposed flap contains the transverse facial artery and the remainder of the superior labial artery *The pictured incisions* cut off the inferior labial artery on both sides The incision completely severs all muscles of expression except the depressors about the angles of the mouth A patient suffering this procedure has been seen within recent months He presented *a tight upper lip and a depressed scar band dividing* each cheek

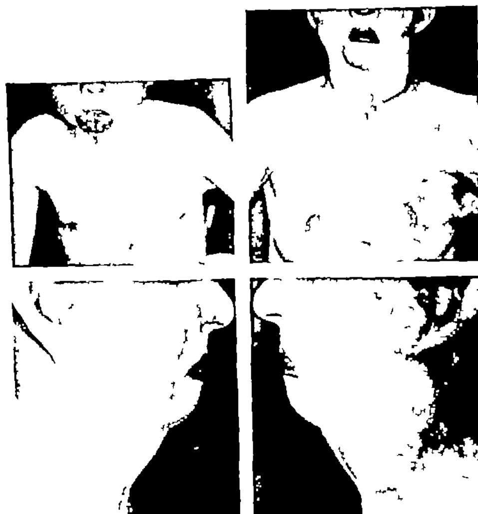


Fig. 174 Burn scar contraction fixing the chin to the neck, axillary contraction limiting arm motion and distorting the breast, ectropion of the lip and so forth. The neck and lip are repaired with a tubed pedicle back flap carrying much fat and badly applied. The flap and, finally the partially opened tube should have been applied without section, and the approximation scars noted about the lip and on the neck.

The operation of *Sedillot* (Fig. 171 *A*) completely destroys the muscles of expression. The distal ends of the outlined flaps might acquire sufficient blood supply from the transverse facial artery which is included in its base but this is questionable. The procedure could



Fig. 172



Fig. 173

Fig. 172. Pigmented hairy nevus. The lesion in the temporal region is replaced by a full thickness skin graft. The lesion on the cheek was partially removed by multiple excision and finally replaced with a split skin graft. Color contrasts do not appear. The graft remains the most arresting feature of the face. (Courtesy of Dr. Warren Davis.)

Fig. 173. Burn scar of the trunk, axilla, and so on, with limitation of arm motion. *a* Split skin grafts in the axilla, scar contraction of the posterior axillary line limiting arm elevation. *b* Badly conceived direct scapular flap based on the shoulder border, loss of the flap with marked scar contraction.

result only in a distorted orifice without expression, the sole function of which would consist of a rigid curtain closing and masking a defect.

The procedure of *Brun* (Fig. 171 *B*) has only one sound feature: the flap is cut in the direction of the blood supply. It has no regard for the levators of the angle of the mouth and the zygomaticus muscle

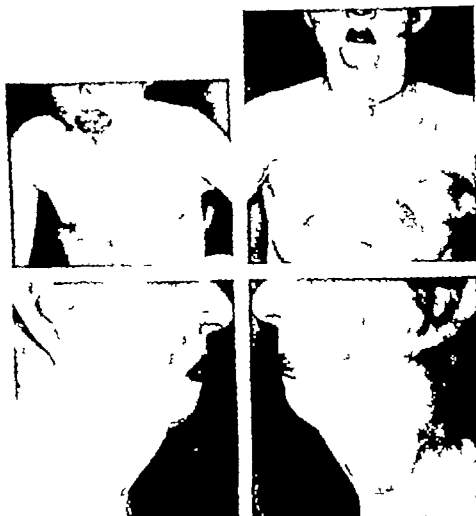


Fig. 174 Burn scar contraction fixing the chin to the neck, axillary contraction limiting arm motion and distorting the breast ectropion of the lip and so forth. The neck and lip are repaired with a tubed pedicle back flap carrying much fat and badly applied. The flap and, finally the partially opened tube should have been applied without section, and the approximation scars noted about the lip and on the neck.



Fig. 175 Many disabilities following scar formation and its contraction result from failure to graft the burned areas promptly



Fig. 176



Fig. 177

Fig. 176 Reverdin ("pinch grafts") grafting of extensive deep burn in inguinal and axillary areas results in this marked scar contraction, with limitation of movement of the arms and legs.

Fig. 177 "Pinch grafting" of a deep burn of the thighs, inguinal and pubic areas results in this contracted scar limitation of lateral extension of the thighs and vulvar distortion.



Fig. 178



Fig. 179

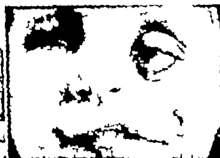


Fig. 180

Fig. 178 Nasal carcinoma badly managed by x-radiation rather than excision.

Fig. 179 Split skin graft of a third degree burn of the lower arm and dorsum of the forearm. This was excellent immediate treatment. The graft and scar should be removed by multiple excision providing normal skin covering with a line scar

Fig. 180 Inexcusable immediate bad repair of the soft tissues with no correction of the deeper structures of the supporting bone.

EXAMPLES OF INJURIES

The following examples of various injuries (Fig. 181) are introduced here to aid the surgeon in his understanding of the subsequent discussions. It is suggested that he appraise the losses in each instance,



Fig. 181 *a b c d* Examples of problems.

plan the various phases and stages of reconstruction and finally consult the relevant text for the method used

There is no fixed formula for reconstruction in many cases. It requires a clear imaginative picture of each procedure and stage ingenuity the ability to improvise at the moment, and a clear knowledge of principles involved to accomplish routinely satisfactory results. The desirable methods of reconstruction of the lip offer a limited choice

of procedure. This limitation is imposed primarily by the desire to conserve and *improve function* The *cosmetic result* is an important



Fig. 181 (continued) e f g g Examples of problems.

secondary consideration. Both objectives are attained by rational, sane choice of procedure.



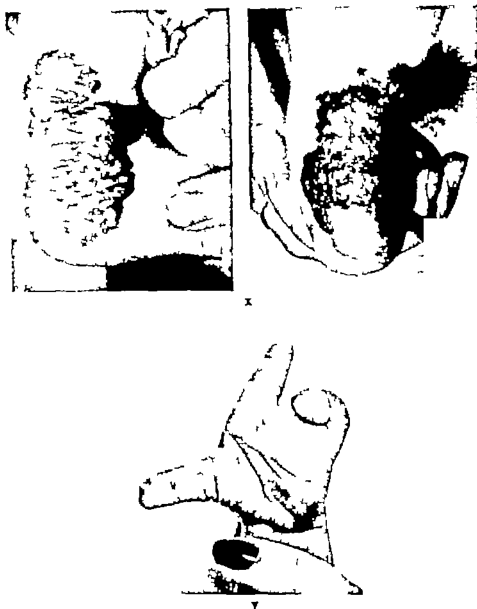
Fig. 181 (continued) h, i, j, j Examples of problems.



Fig. 181 (continued) *k k*, *l l* Examples of problems.



Fig. 181 (continued) *s* and *t* Examples of problems.



x

y

Fig. 181 (continued) *x* and *y* Examples of problems.



w

Fig. 181 (continued) w Example of a problem.

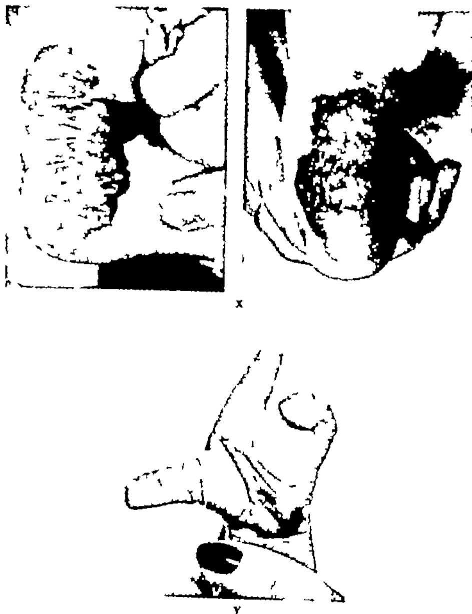


Fig. 181 (continued) *x* and *y* Examples of problems.

Chapter V

DEFECTS OF SCALP AND CRANIUM

Defects of the scalp are best repaired by *flaps* obtained from the borders of the defect, when ample material is available Little can be gained by undermining and stretching the scalp except in the anteroposterior direction. Scalp has no elasticity of practical value. This can be increased materially by incising the galea in parallel transverse lines. Consequently only small defects can be closed by sliding and approximating the margins of the defect. Only those flaps which are rotated or interlaced, or both, can gain advantage from the slight movability of the scalp Adequate relaxation incisions permit frequently greater shifts of scalp (Fig 183) The defect created heals by granulation Residual defects of any considerable size can be repaired with *flaps of split skin* applied immediately in the presence of a clean pericranium or after the growth of a granulation bed on denuded bone (p 268) Such a bed *is produced by drilling to the diploe at frequent intervals* and dressing with potassium chloride (0 65 per cent) to stimulate growth (Fig. 182) *Tubed pedicled flaps* can be caterpillared" from the posterior or anterior surface of the thorax or better transported on the wrist and forearm as a carrier Such a flap may be used on the upper arm if scarring is permissible An adequate amount of skin is included in this flap and tube (Figs. 8 38)

Bone, Cartilage. Losses of the skull are best replaced with bone, but can be bridged and protected by strips of diced or shredded implanted cartilage. Cartilage does not unite with bone but is simply encapsulated

in position to furnish a protective covering and restore contour Small defects of contour, particularly losses of the outer table in the frontal area, can also be corrected with implanted dermal grafts. Bone for repair of these defects may be obtained from the ilium or tibia The ilial bone may be utilized either as a cancellous block, diced or meal The tibia is an excellent source of osteoperiosteal grafts, and can be utilized either as a *block* or as an *osteoperiosteal graft* The latter is frequently the graft of choice Metal plates of any type are foreign bodies and should not be used.

PARTIAL LOSSES OF SCALP—SMALL AND LARGE

Partial small losses of the scalp result from trauma infection surgical removal of pathological conditions, and burns The burn is of course, a trauma, but differs markedly in its effect on surrounding tissue and the depth of involvement. It is rare that the closure of such losses warrants grafts or flaps from a distance. The careful planning of a bordering scalp flap is usually adequate

Partial large losses merely present the same problem but to a greater degree. The planning of the scalp portion of the management remains the same either with or without underlying bone loss, surface (external plate) or total. The location of the loss does not materially affect its repair provided that the meninges are intact.

Large losses admit of repair with hair-bearing scalp without grafting Grafts may be used for temporary covering of the denuded area resulting from the shifting of a large flap (Figs. 183, 197, 200) and this hairless grafted area is corrected later by multiple excision and approximation of hair bearing scalp (see p 271)

The planning of a type of flap and its use or management depends largely upon the available bordering blood supply

Examples:

1 The double pedicled flap to close the small loss in Case II (Fig. 183 p 271) depends upon the collateral of the supra-orbital posterior auricular and occipital arteries

2 The bordering scalp in the large parietal-temporal loss in Case I (Fig. 198 p 293) retains all its normal vascular supply except the temporal and distal end of the posterior auricular arteries This allows an incision which permits freeing of the entire scalp its necessary rotation and various advancements.

3 The large occipital and parietal loss in Case II (Fig. 199 p 295) permits the choice of only one type of flap if further cosmetic disability is avoided.

All the normal scalp vessels are available to the borders of the loss. The incision of a suitable flap sections the posterior auricular artery and either the temporal or occipital artery Flaps based upon the occipitals would have a questionable anterior blood supply even after repeated delays" Their use would create an objectionable cosmetic disability

These flaps are supplied by the frontal and parietal branches of the

anterior temporal arteries. Two "delays" were required to shift them safely

The procedure stimulated hair growth on a bald scalp

4 The loss shown in Figure 200 (p 296) is practically the total temporal and parietal scalp bone and so forth. Viable scalp was necessary to cover a tantalum plate and some exposed dura mater

The evident incision to the right of the sagittal line provides an adequate anterior and occipital blood supply through double pedicles

The defect is covered with split skin which may be removed by multiple excision

5 The loss shown in Figure 197 (p 292) results from a third degree burn It includes the right frontal part of the parietal and much of the temporal area. The branches of the temporal artery function.

A modified Z type of incision permitted exchange of the scar flap with temporal posterior auricular and occipital arterial supply for a hair-bearing flap from the parietal occipital area of the opposite side. The latter flap has temporal, posterior auricular and occipital arterial supply The scar flap is removed by multiple excision.

The loss in Case I (Fig 182 p 269) is total. There is no choice of procedure admitting the use of bordering tissue

The surgeon may choose (1) free skin grafts (2) pedicled flaps from the back thoraco-epigastric area (3) abdomen and (4) the arm.

A back pedicle based on the neck and shoulder permits transfer of its distal flap to the skull (see Fig 4 p 7) The thoracic and abdominal tubes may be caterpillared" or transferred on the wrist and forearm as a carrier (see Figs 7 39 290) The former procedure is not desirable. The arm flap based on the shoulder is readily transferred to the skull (see Figs 8 290 442)

TOTAL LOSSES OF THE SCALP

These present entirely different requirements as the result of loss of usable bordering tissue and the adverse distribution of the surrounding blood supply

There is no choice of procedure. One must use skin grafts of varying thickness or pedicled flaps from a distance This total loss may or may not be associated with loss of bone as the result of the traumatizing agent It is highly probable however that this results in some degree of loss of some portion or all of the external table at least.

Case I. Total Loss of Scalp; Small Areas of Periosteum and Necrotic Areas of the External Table This female patient's hair was twisted on a line shaft rotating 1750 times per minute. The scalp was torn from before backwards from bordering skin along lines as sharp as though they had been incised. This included the upper thirds of both upper eyelids.

The friction and resultant heat sufficiently damaged the outer skull table at points of contact to cause surface necrosis and sequestration.

The periosteum was denuded over an irregular area (8 by 4.5 cm) on the left parietal bone and a smaller area on the right side (Fig. 182, c p. 269)

The patient arrived for care eight days after the injury The skull was covered with clean granulation everywhere except on the denuded areas.

Procedure (Twelve Days after Injury) STAGE 1

1 A split skin graft (0 018 inch) was taken from the thigh or abdomen. Four drums were taken from the thigh and a partial one from the lower abdomen in this case.

2 Suture was applied to the skin borders and also the overlapping borders of the various grafts.

3 Strips of 30 mesh petrolatum gauze powdered with sulfathiazole or penicillin were applied.

4 A covering of fluffed gauze was put on.



Fig. 182. Case I total loss of scalp and bone injury See detailed text (p 268)

5 An Ace bandage was applied with moderate pressure.

6 The wound was redressed in five or six days.

7 Procedure as indicated until sutures, and so on, were removed. The area was oiled with nursery oil and exposed to the air

There was total growth of these grafts for sixteen days, when small areas of liquefaction appeared in the frontal and parietal areas. This loss increased rapidly in these areas. Several thin plaques of sequestrum were removed from the external table. Granulations appeared, but remained soft in spite of treatment. Two large areas of frontal bone remained bare (Fig. 182, *d*)

STAGE 2.

1 The granulations were removed.

2 All suspicious external table areas were curetted.

3 Several points in the exposed bare bone were trephined to the diploe (Fig. 182, *d*)

4 The area was dressed with petrolatum 30 mesh gauze dusted with urea (2 per cent) until the small areas epithelized and the frontal granulations were ready for graft.

There was an interval of ten days.

5 The frontal was grafted with split skin (Fig. 182, *g* p. 269)

An interval of five months elapsed.

STAGE 3

1 New eyebrows were grafted (see Fig. 191 p 281) The graft for the right side was removed from the hair-bearing scalp over the right mastoid. The left one was removed from the left midocciput. Both grafts failed to grow on the scar bed and poorly vascularized surrounding skin covering. This grafting was repeated again after six weeks with the same result. It was done again in four months. Narrow strips, 2 mm. wide, cut on a bevel in the direction of the hair follicles, were removed from the remnant of hair-bearing occiput. Three such strips of required length were placed in the prepared bed. The ultimate result was the same as above. Bunnell advocates this method.

The condition of the scalp was such after another two months period that a "transformation" (wig) and artificial eyebrows were permissible.

TUMORS OF VARIOUS TYPES

The requirement of successful management of the various types of tumors—both benign and malignant—are well known. It is not the purpose of this discussion to present these but, rather to indicate desirable methods of reconstruction of the residual soft parts and supporting structures after their adequate removal.

Case II (Fig. 183) This case presents several problems in planning the management. The lateral surface of the upper lid and canthal region had to be cleared without distortion and minimum scar the temporal area to be replaced with normal facial skin with a fine scar at the edge of hair-bearing scalp a large area of frontal-temporal hair bearing scalp to be replaced.

Inasmuch as this was a benign tumor the choice of procedure was multiple excision, utilizing the skin of the cheek for new covering of the hairless area. The defect in the parietal-temporal area following excision was corrected by advancement of bordering hair-bearing scalp after a relaxation incision. This flap had blood supply from the collateral of the supra-orbital, the posterior auricular and occipital arteries.

The scalp defect resulting from the relaxation incision and advancement is outlined in Figure 183 *c* This area was grafted with thin split skin and allowed to contract. The residual graft was then multiply excised and the hair bearing scalp approximated.

The incision for advancement of the cheek skin was pre-auricular (see Fig. 232, p 344) This skin was undercut to the margin of the mandible.

Meticulous postoperative care of the approximated area for six weeks leaves a fine scratch line scar which is almost invisible in this particular skin.

Procedure STAGE 1

1 An incision was made, beginning in the upper lid just lateral to the canthus, which curved upward, outward and downward through the tumor along the hair line (*AB*)

2 The incision was continued to the anterior attachment of the helix (*B*) down along the mesial surface of the tragus to the lobule, along the attachment of the lobule to the cheek and to the point (*C*) of a triangular incision below the lobule which approximated the attachment of the skin behind the lobule when the skin of the cheek was elevated. The other arm of the triangular incision curved upward and outward along the attachment of the lobule and through the lower posterior skin attachment of the ear (*CD*)

3 An incision was made from the point of beginning (*A*) along the inferior normal skin border of the tumor to the first incision at the posterior border of the tumor (*B*)

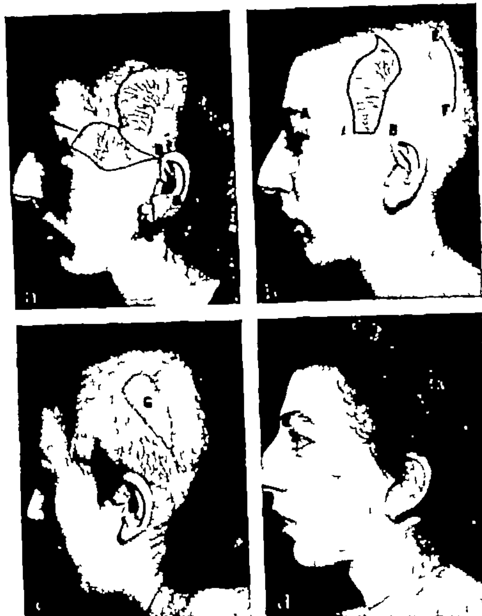


Fig. 183 Case II benign verruca removed by multiple excision. *a*, Stage 1 the original condition and the incision through the scalp and skin about the ear *b* Stage 2 the healed result of Stage 1 incisions for total removal of the tumor and relaxation to permit advancement of the hair-bearing temporal parietal scalp *c* Stage 3 the result of Stage 2 and the contracted skin graft, *G* which is to be excised. *d* The finished result.

4 The entire normal cheek skin was freed to a vertical line through the angle of the mouth by sharp or blunt dissection in the connective and fat tissue above the superficial fascia.

5 The tumor was removed between its bordering incisions.

4 The area was dressed with petrolatum 30 mesh gauze dusted with urea (2 per cent) until the small areas epithelized and the frontal granulations were ready for graft.

There was an interval of ten days.

5 The frontal was grafted with split skin (Fig. 182, g p. 269)

An interval of five months elapsed.

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3 An incision was made from the point of beginning (*A*) along the inferior normal skin border of the tumor to the first incision at the posterior border of the tumor (*B*)



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4 The entire normal cheek skin was freed to a vertical line through the angle of the mouth by sharp or blunt dissection in the connective and fat tissue above the superficial fascia.

5 The tumor was removed between its bordering incisions.

6 The cheek skin was elevated and approximated with sharp hooks and fine (0000) dermal sutures.

7 The skin in and about the ear was adjusted and sutured.

8 Traction of the cheek skin was relieved with a 2 inch strip of 30 mesh gauze applied with nonflexible collodion to the cheek and scalp.

Note the scar from the canthus to the ear (Fig. 183 *b*)

STAGE 2 (Six months later- half of this time is sufficient for return of normal elasticity)

1 The remaining tumor was excised (Fig. 183 *b*)

2. An adequate flap of hair bearing temporal-parietal scalp (*EF*) was outlined and incised to close the defect and restore the normal hair line. The blood supply of this flap depended upon the collateral from the supra-orbital, the posterior auricular and occipital arteries. This was a relaxation incision.

3 The anterior border of the flap was sutured. The scalp defect (Fig. 183 *c*) was covered with a Thiersch graft (*G*) to close and obtain maximum contraction.

STAGE 3 This consisted in multiple excision of the grafted area and approximation of hair bearing scalp It was begun in three months, repeated at similar intervals, and complete in three periods.

Case III. This patient had a brownish black, elevated hairy nevus. It began at the inner margin of the brow extended up the median line into the hairy scalp 1.5 cm. and laterally over the entire left frontal area and into the hairy scalp 2 cm. The lateral third was very black. Biopsy did not indicate any active melanosis.

The problem was much different from the preceding one, but the surgeon's responsibility to the patient was the same. It seemed feasible to effect a desirable result by a combination of multiple excision and Z plastic to aid in frontal scalp advancement and the removal of the lesion by gradual excision of one of the Z flaps. The obligation could not be met with any type of graft—by exchanging one cosmetic disability for another

Procedure. STAGE 1

1 An incision (*AB*) was made along the upper border of the eyebrow and along the margin of the lesion to its termination in the hairy scalp (*AC*)

2. Free separation of the forehead and hairy temporal scalp to the ear was effected, permitting considerable advancement.

3 *The normal scalp was drawn laterally to overlap the nevus, which was incised* along the overlapping flap and sutured (Fig. 184 p. 273)

STAGE 2. Further useful advancement of the normal forehead was impossible without relaxation and variation in the lines of traction.

1 A vertical incision was made the length of the former scar (*AC*) and a Z (*EDFG*) incised on this line so that the upper lateral arm (*DE*) followed the hair line of the normal scalp and the lower one (*FG*) began at about the junction of the lower and middle thirds of the forehead and extended into the lesion, to accomplish this purpose. It outlined four flaps *BAFG DFG EDF* and *CDE*. The entire right forehead scalp was freed through the incision *ADE* and the parietal-temporal scalp to the level of the superior helix of the ear through the incision *CDE*. The two triangular flaps of the Z were transposed so that the point *F* of the flap *DFG* was sutured at the point *E* on the hairy scalp and the point *D* of the hairless flap *DEF* was sutured at the point *G* In shifting and approximating these the point *D* of the parietal flap *CDE* was drawn laterally into the nevus toward the point *G* The rotation of the flap *EDF* and the required traction to approximate *D* at *G* moved the point *A* on the hairless scalp to the midpoint of the orbit (*H* in Fig 184) Figure 184 c pictures the result of the second stage.

STAGE 3 The point *G* was further advanced laterally after incising the line *IGHA* and the angular point of *CE* after incision in this line. The result is pictured in Figure 184 *d*

STAGE 4 The fourth and completion stage consisted of incision along the line *CEGI GH* and *AHB* (Fig. 184 *c*) the advancement laterally and downward of the angular point in the flap *CEI* and the advancement laterally and upward of the point *G* of the flap *IGH* The traction of this flap removed the fullness over the inner can-

thus, permitted the excision of the pigment under G met the advanced point in CEI and established the normal temporal hair line. Two fine visible scars remained beyond this hair line



Fig. 184 Case III benign hairy melanoma multiple excision. (See p. 272 for detailed procedure and significance of the letters.) *a* The original condition *b* result of Stage 1 and the incision for Stage 2, *c*, result of Stage 2 and the incisions for Stage 3 *d* result of the previous stage and the incisions for concluding correction.

The patient left this area during the early military period in 1944 and has not returned for this concluding procedure.

Case IV Benign Hairy Melanoma. The extent and distribution of the pathology in this case differs materially from the preceding Cases I and II It is desirable again to gain the maximum by shifting the normal forehead scalp

The available desirable skin to replace the pigmented area from below the

zygoma, over the temporal area and above the eyebrow is the facial covering. This is elevated from the cheek and the neck below the mandible to establish the normal temporal frontal skin hair line and replace the residual frontal pathology.

The skin covering the temporal and frontal region beyond the hair line of the pathologic condition is normal and satisfactory.



Fig. 185 Case IV benign hairy melanoma multiple excision. (See p. 273 for detailed description of the procedure and significance of the letters.)

Procedure: STAGE 1

1. An incision (*A*) was made from the lowest mesial point of the nevus around the eyebrow to *B*. This was continued in the normal frontal scalp into the hair bearing scalp to the point *C*.

2. The incision was continued along the line *ADE* and down the ear attachment to the lobule, continued mesial to the lobule to the point *F* and then upward and backward along the posterior attachment of the ear to the point *G*.

3 The skin was elevated by either sharp or blunt dissection above the fascia to a line several centimeters below the mandible. The forehead and adjacent hair bearing scalp were freed

4 The normal scalp was drawn over the nevus to the maximum degree, and the nevus was incised along this line.

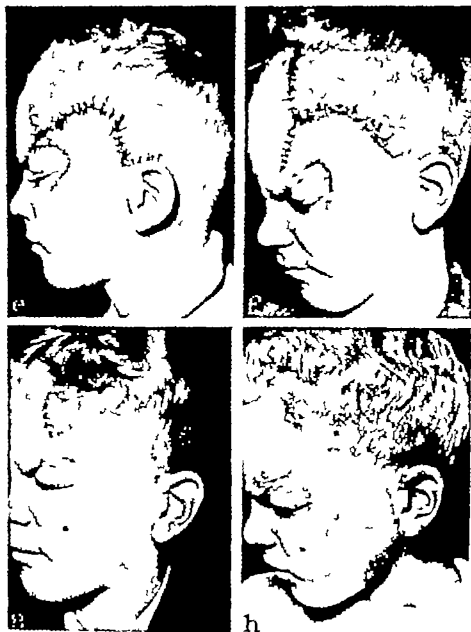


Fig. 185 (continued) Benign hairy melanoma.

5 The cheek skin was drawn upward and mesially to the maximum, and the nevus was incised along its superior border

6 The nevus was excised between the incision and suture (Fig. 185 *c*, *d* p 274)

STAGE 2.

1 An incision was made along the entire scar resulting from Stage 1

2 The cheek and neck skin were elevated as in the first stage.

3 The nevus was overlapped with the elevated skin and incised as in the former procedure.

4 The incised nevus was excised and sutured as previously (Fig. 185 e)

STAGE 3 The procedure of the Stage 2 was repeated. The healed result is pictured in Figure 185 f

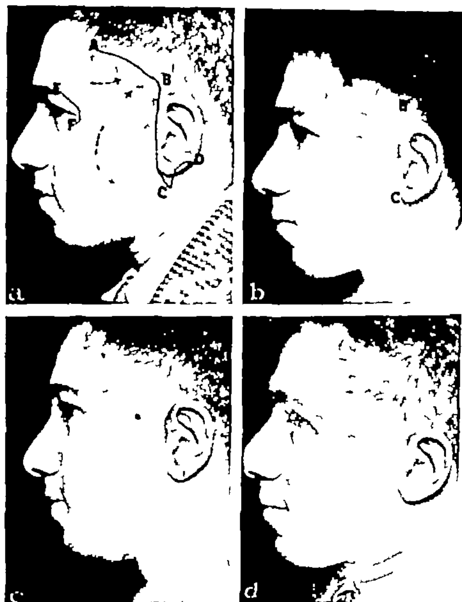


Fig. 186 Case V benign melanoma of the cheek, helix of the ear and the temporal frontal area. (See text for a detailed discussion of the procedure.)

STAGE 4 A repetition of Stage 3 (see Fig. 185 g)

STAGE 5 The procedure of Stage 4 was repeated to conclude the case.

Case V This case is offered because it presents a black, pigmented nevus involving the cheek to the tip of the ear lobule, the skin about the external canthus, the anterior helix of the ear and all the temporal area in a man with a heavy beard. He had, however in the malar and infra-orbital area excellent hairless skin well demarcated from his beard (Fig. 186 b)

A variation in planning the management, longer intervals between the various procedures, during which the area was massaged and stretched, permitted the removal of the entire lesion excepting that on the helix of the ear Eight procedures at intervals of three to six months were required to produce a normal repair

Procedure This differs from those described in Cases I, II and III in the direction of skin shifting and traction.

The result of Stage 1 is pictured in Figure 186, *b* The second stage is seen in Figure 186, *c*

The final result, at the end of eight procedures, is seen in Figure 186, *d*

Case VI (Neurofibroma). The patient, aged forty four years, presented a large neurofibroma of the right supraorbital scalp and mesial end of the upper lid. There were numerous small lesions in the skin over the face and body This large lesion was operated on when the patient was fourteen and again ten years later without



a b

Fig. 187 Case VI neurofibroma operated on 30 and 10 years previously

result. The period of involvement, the necessity of useful vision, the lack of mitosis, and so forth determined its removal.

Procedure

1 The mass was elevated, and an incision *ABC* (Fig. 187 *a*) was then made in the apparently normal scalp in the median line beyond the border of the tumor

2 The scar of the previous surgery (*DC* in Fig. 187 *a*) was incised, and this tissue dissected from the fibers of the frontalis and corrugator muscles above and below The involved medial portion of the lid was included.

3 The scalp was freed laterally on both sides.

4 A heavy suture was passed through the apparently normal scalp outside the tumor on the right side, through the normal scalp on the left side, and back through the scalp on the right side near the point of introduction Strong traction on this suture drew the normal scalp beneath the involved area. Necessary traction was exerted on the lower involved tissue, and an excision made along the border of the normal scalp.

5 Suture was made.

There has been no evidence of local recurrence for fifteen months.

INFECTIONS

Infections of various types may result in necrosis and require the same treatment discussed under small losses It is extremely rare that such losses require grafts, with the subsequent necessity of cosmetics or tattooing to obtain a presentable appearance.

There is, however, one of moderate frequency lupus, which requires the treatment of a malignancy and varying degrees of reconstruction

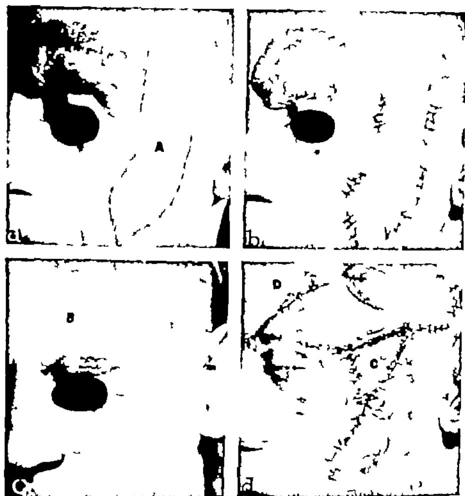


Fig. 188 Case VII lupus. (See text on p 279 for detailed description of the procedure.)

to obtain a desired result. The author has had a moderate experience with this lesion through the years. The patients have originated mainly in the countries of western Europe. Most of them have had one of the treatments commonly given and, frequently have been free from visible lesions for varying periods of time We are impressed with the belief that the infection spreads by continuity (cellular involvement) and through the local lymphatics The results of wide excision and reconstruction have been gratifying Such management is a big improvement cosmetically psychically and economically

Case VII. Lupus. This was a large lesion involving: (1) the left half of the glabellar area and adjacent scalp superiorly for 2.5 cm. and laterally to a vertical line through the external canthus (2) the upper half of the upper lid.

The center of this area was treated by Finsen light ten years previously and was not objectively involved at this time. The U-shaped, active lesion was invading from the borders of this treated area.

It is desirable to excise the lesion widely cover the resultant defect with well nourished skin of the color and quality bordering it and provide an eyebrow A proper hair bearing scalp graft (see Fig. 191) in this treated area is not advisable

The desired skin *with a hair bearing margin* can be rotated from the cheek with a blood supply acquired from the temporal artery Such a flap, cut against the direction of blood supply requires several "delays."

Procedure STAGE 1

1 Incise an outlined flap such as *A* Do this so that the lateral incision includes sufficient hair-bearing skin for an eyebrow (Fig. 188 *b* p 278) One half of the width of this flap is hair bearing.

2. Suture and tie lightly

An interval of three or four weeks elapses.

1 Incise parallel sections of the previous incisions. Separate *these sections of the flap* above the fascia. Suture.

2. Incise and separate the remaining sections of the flap after another such time interval. Suture.

3 Incise and elevate the distal end of the flap One half of this flap was elevated and returned to its bed for another time interval.

4 Incise widely about the borders of the lesion. Remove it to the periosteum. Graft the defect with thick split skin (*B*) (Fig. 188 *c*)

STAGE 2.

1 Elevate and rotate the flap which is now viable.

2. Excise the part of the skin graft overlapped by the flap. Use this to close the facial defect after sliding and closing the defect left by the flap (*C* in Fig. 188 *d*)

An interval of two months elapses.

STAGE 3

1 Incise the superior border scar about the flap

2. Separate its upper half Rotate and extend it to replace the residual skin graft (*D*)

3 Remove the triangular graft (*C*) in the face.

4 Undermine its borders and close.

HEMANGIOMA

This lesion in some form—capillary cavernous or mixed—is frequently presented for management (see p 234)

We are opposed to radiation of this area by x ray radium or radon seeds We accept contact x ray in doses not exceeding 100 r at intervals of six months or longer

Some lesions do well with sodium morrhuate 1 minim of 5 per cent solution in a half dozen spots at intervals of 1 cm repeated each six to eight weeks

We prefer to excise and reconstruct, as previously described

EYEBROWS: DISPLACEMENT AND PARTIAL AND TOTAL LOSS

These losses result from various causes burns trauma disease and, occasionally congenital defects.

Displacement

Case VIII. This patient suffered a comminuted, depressed fracture 5 cm in diameter in the frontal parietal area. There was complete separation of the anterior

attachment of the temporal muscle. The scalp and bone loss resulted in a depression of 1 cm. and the displacement shown in Figure 190

The bone loss was corrected with two strips (7.5 by 2.5 cm.) of osteoperiosteum from the tibia, a resultant frontal depression with a dermal graft 10 by 5 cm., and the brow displacement by the transposition of flaps (Fig. 190)

This simple procedure is evident without description



Fig. 189 Cavernous hemangioma.

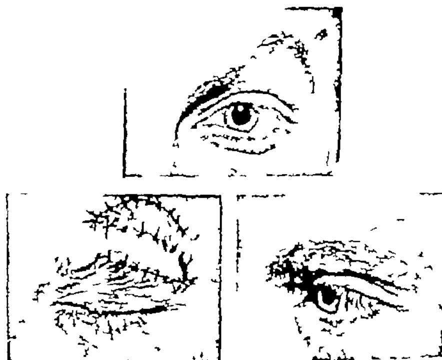


Fig. 190 Case VIII displaced eyebrow correction by transposition of flaps.

Replacement in Partial and Total Loss

The absence of an eyebrow is a striking cosmetic disability The brow can be restored by one of several procedures (1) The opposite

brow can be divided lengthwise and half of it transferred to replace the absent one. (2) Hair from the temporal region can be taken from behind the ear or the midline of the occipital region The chosen flap must furnish hair growing in the *proper direction* for the new brow

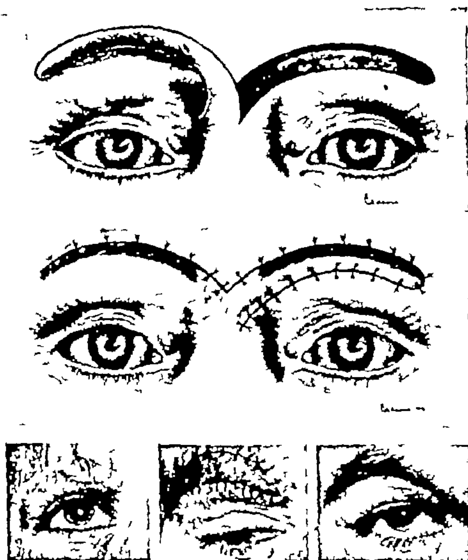


Fig. 191 Replacement of eyebrow *Upper bilateral view* Pedicled flap containing frontalis artery in its base and including half of existent eyebrow preparation of bed for transposed flap *Lower bilateral view* transposed flap approximation with simple suture *Bottom row left* Absence of eyebrow *middle* replacement with scalp graft from behind ear appearance of graft on twelfth day *right* new eye brow

LOSS OF BONE WITH INTACT SCALP

These losses may be congenital failures of development with or without abnormal conditions of the scalp and musculature There are usually accompanying asymmetries due to varying bone development and abnormalities of the soft parts.

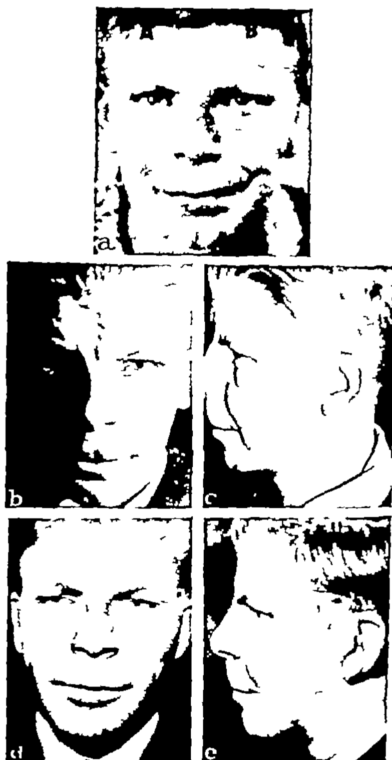


Fig. 192. Case I congenital developmental disability of the forehead and face. (See p 283 for detailed description and procedure.)

They may result from trauma with comminution and bone loss with an incised scalp or they may follow trauma and subsequent osteomyelitis beneath an intact scalp The osteomyelitis may result from infection without injury The scalp is involved secondarily by the bone infection and suffers no injury except in the surgical management.

Case I. The patient suffers two types of congenital deformities one in the skull and its covering soft parts and the other in the soft parts of the face producing cosmetic disabilities subjecting him to derision and marked psychic disturbances.

1 There is a deep groove along the frontal suture line extending upward beyond the hair line. This results from the presence of a thin inner table as a floor and the absence of diploe and external table The latter defect extends upward and outward on both sides from the nasofrontal articulations to points in the hair line above the supra-orbital foramina (Fig. 192, *a* *b*)

2. Redundant frontal scalp

3 Hypertrophied corrugator muscles lying across weaker frontalis muscles at an angle of 45 degrees Their contraction produces deep frown lines and a roll or fold in the loose scalp (Fig. 192 *b*)

4 Thick scalp rolls or folds on either side of the median groove

5 There is adhesion of the skin and fascia to the periosteum from the inner canthus downward and outward beneath the malar This results in an overlying roll or fold of the soft tissues both above and below this adhesion, producing a grotesque appearance

6 The lobules of both ears are malpositioned (Fig 192 *c* *e*)

These cosmetic conditions should be corrected without additional disabilities.

Procedure STAGE 1

1 Make an incision 5 cm long across the sagittal line of the hairy scalp parallel to the hair line and 2.5 cm. posterior to it.

2. Free the scalp from the periosteum by sharp and blunt dissection over the entire depressed area

3 Remove sufficient skin from the abdomen to provide a double layer of dermal implant (see p 135) in this entire area.

4 Determine the width of the second layer required to overcorrect the central grooved depression Fix this to the first layer with several 00000 plain catgut sutures.

5 Pass strong Dermalon sutures threaded at both ends on straight cutting needles through the inferior outside edges and the center of the implant (see p 135) Insert tubular guards to the point of emergence of the needles and pass them

6 Utilize these traction sutures to draw the implant in the desired position and tie them lightly over a piece of rubber tubing. Remove them in three or four days

7 Suture the scalp and dress firmly with fluffed gauze and a Gauzetex bandage.

An interval of twelve days elapses.

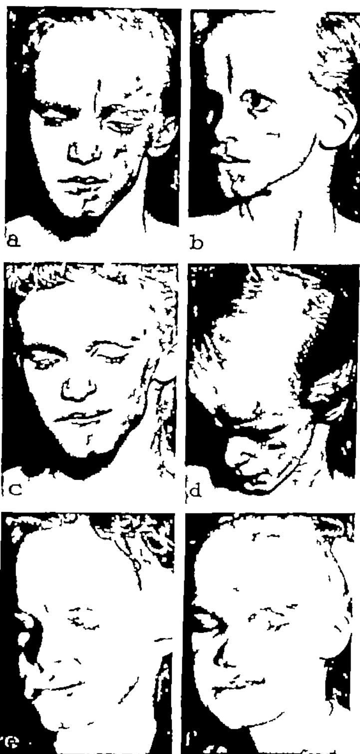


Fig. 193 Case II congenital developmental asymmetry of bone and soft tissue. *a*, *b* *c* *d* Original condition *e* result of Stage 2 in the reconstruction *f* result of Stage 3 (See p 285 for detailed description and procedure.)

STAGE 2

1 Make an incision from the attachment of the helix which passes on the mesial surface of the tragus and emerges at the attachment of the lobule (Fig. 192, *a* p 282) This conceals this scar

2 Separate the skin from the tragus by sharp dissection. Continue the separation of the facial skin to the curved adhesion around the orbit and malar by blunt dissection in the fat and connective tissue above the fascia. Cut the entire length of the adhesion from the skin in this plane.

3 Introduce a dermal implant as described in Stage 1

4 Suture the incision with 00000 Dermalon and dress as previously described.

An interval of four weeks from initial surgery elapses.

STAGE 3

1 Make skin incisions along the superior hair line of the brows to their median ends.

2 Dissect the scalp superiorly Isolate the corrugator muscles and excise

3 Close the incisions with 00000 Dermalon

The redundant scalp with the abnormal corrugator musculature and years of habit, would not and could not remain smooth subject to the action of these muscles The final result (Fig. 192 *d e*) is acceptable cosmetically and mentally

Case II. Congenital asymmetry of both bone and soft tissue does not require description. Note the maldevelopment of the left frontal as contrasted to that of the bony frame of the balance of the left side The trophic changes of the soft tissues of this side are equally striking as the bone situation. The left parietal area is bald

Varying degrees of this condition present themselves frequently It is the responsibility of the surgeon to produce an acceptable cosmesis with autogenous material *Tantalum mesh wires and plates or other foreign material should never be used for this purpose*

The procedure of correction follows that described in the preceding type (Fig. 192 p 282) This case furnishes an excellent example of the behavior of dermal implants and the consequent necessity of planning several procedures in which the maximum viable implant is used The maximum amount—a double layer—of certain viability is utilized on each occasion.

Double dermal implants were made first in the inframalar depression along the mandible through a pre auricular incision and in the left frontal depression (Fig. 193 *a b* p 284) The result of this is seen in Figure 193 *c*

The second implants, three weeks later were made in the median forehead depression (Fig 193 *e*) and in the diagonal one running upward and outward from the left eyebrow These were placed through incisions in the hair line (Fig. 193, *e*)

The third implants, ten months later were placed in the mental and infra-orbital areas The result is seen in Figure 193, *f*

A fourth implant was made in the mental depression two years later This smoothed the line of the mandible

The net result of the management is satisfactory It should be in spected annually with the probability that small corrections will be de sirable after several years.





Fig. 194 Case III cranial loss without defect in the scalp *Above,* Loss of the supra-orbital ridge, frontomalar process, and surrounding frontal bone: loss of the eyeball, tissue from the upper lid, and part of the auricle and helix. *Lower left,* The same. *Lower right* Result of reconstruction with an osteoperiosteal graft inserted beneath a scalp flap including the supra-orbital artery in its base.

Case III The patient presents a loss of the supra-orbital ridge, frontomalar process and surrounding frontal bone without loss of scalp This and other losses pictured in Figure 194 result from trauma—a high speed missile in this instance

The repair of the bone loss may be satisfactorily accomplished with either an osteoperiosteal graft, with iliac cancellous chips or meal This reconstruction was accomplished thirty years ago before the recognition of the value of the chips or meal.

Procedure Make an incision to the periosteum to outline a flap including a blood supply, about ⅜ inch (about 1 cm) from the bony border of the defect. Separate and elevate the included flap Separate and retract the periosteum to the edge of the incision in the scalp With a chisel or burr freshen the cortex of the bone from its free edge to the periosteal attachment Cut sufficient osteoperiosteal graft from the tibia to cover the defect Cut it into proper lengths (pp 38, 40) Place the strips across the defect so that their bony surfaces rest on the freshened cortex. Draw the cranial periosteum over the periosteal surface of the graft. Close the scalp with interrupted sutures Apply a gauze dressing with a firm bandage Figure 194 pictures the result of such a repair

Case IV Loss of the Outer Table over the Frontal Sinus and Glabella; Displacement of the Eyebrow and Inner Canthus. The patient, aged 35 years, was kicked on the left forehead by a horse at the age of two years. This incised the scalp and comminuted the outer table covering the frontal sinus and glabellar area.

There is a scar beginning 2.5 cm. below the internal canthus and extending upward and outward across the glabella and forehead. A scar 5 cm. long along the upper margin of the eyebrow joins the vertical one near its upper end.

The comminution and bone loss produced a cavity 2.5 cm. long and 0.5 cm. deep along this retracted glabellar scar The eyebrow is elevated and the inner canthus displaced downward 0.3 cm.

Procedure, STAGE 1

1 A Z incision, *ABCD* (Fig. 195 p. 288) was made, using the present scar for its central and upper lateral members.

2. Both triangular flaps were dissected from the scar so that transposition could place the eyebrow in its normal position without traction.

3 A piece of preserved cartilage (Fig. 195) was carved and implanted to restore the normal contour in the depressed cavity

4 The flaps were transposed and sutured with 0000 Dermalon.

5 A moderately firm dressing was applied.

An interval of two months elapsed.

STAGE 2.

1 The displaced inner canthus was corrected, utilizing the old scar as the central member of the Z incision *DEF*

2. The triangular flap was dissected and transposed.

3 Suture was made with 0000 Dermalon.

Case V This patient suffered a frontal bone injury from a fall at the age of four years. He had surgery at this time (1929) for a suppurative sinusitis on the left side. He was clinically normal until 1940 at which time he had further surgery The bone pathology continued. He came with a draining fistula in 1942 for further surgery

Large frontal sinuses presented increased density and mottling of the bone of the external table of the frontals over the sinuses. The balance of the frontals was negative.

The external tables of both frontals were soft up to 1 cm. from the superior borders. They were removed. The internal tables were objectively negative, except a fistula in the internal table of the central sinus cavity

The large frontal bone defect was closed and contour restored with diced bone four years later (1946) Figure 196 (p. 289) shows the condition of this bone several weeks later the same figure also shows the perfect repair in 1948

Procedure STAGE 1

1 A scalp incision was made along the upper hairy margin of both eyebrows and across the glabella.

2. The scalp and periosteum were reflected upward over the entire frontal bone.

A fourth implant was made in the mental depression two years later This smoothed the line of the mandible

The net result of the management is satisfactory It should be in spected annually with the probability that small corrections will be de sirable after several years



Fig. 194 Case III cranial loss without defect in the scalp *Above* Loss of the supra-orbital ridge frontomalar process, and surrounding frontal bone loss of the eyeball, tissue from the upper lid, and part of the auricle and helix. *Lower left* The same. *Lower right* Result of reconstruction with an osteoperiosteal graft inserted beneath a scalp flap including the supra-orbital artery in its base.

Case III. The patient presents a loss of the supra-orbital ridge fronto-malar process and surrounding frontal bone without loss of scalp This and other losses pictured in Figure 194 result from trauma—a high speed missile in this instance

The repair of the bone loss may be satisfactorily accomplished with either an osteoperiosteal graft, with ilial cancellous chips or meal. This reconstruction was accomplished thirty years ago before the recogni tion of the value of the chips or meal

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4 The flaps were transposed and sutured with 0000 Dermalon.

5 A moderately firm dressing was applied.

An interval of two months elapsed.

STAGE 2.

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The large frontal bone defect was closed and contour restored with diced bone four years later (1946) Figure 196 (p. 289) shows the condition of this bone several weeks later the same figure also shows the perfect repair in 1948

Procedure. STAGE 1

1 A scalp incision was made along the upper hairy margin of both eyebrows and across the glabella.

2. The scalp and periosteum were reflected upward over the entire frontal bone.

below and then back through the scar close to the point of beginning. This suture draws the edge of the normal skin below the scarred skin and, under traction, to the maximum level or line of excision and subsequent suture without difficulty (see Meloplasty p 350, Fig. 236)

7 Excision was done.

8. The two flaps were approximated with simple catgut sutures at intervals of 2 cm.

9 The edges were closed with 0000 Dermalon.

10 Traction was relieved with a strip of 30 mesh gauze 4 cm. wide applied to the cheek and scarred frontal area with nonflexible collodion.

An interval of six weeks elapsed.

STAGE 2. The skin was massaged or rather stretched by traction made with the ball of the thumb and first finger for several minutes three or four times daily during the latter third of this period.

1 The scar line was incised and treated as previously The upward traction draws the skin from the lateral neck and that of the submaxillary area upward toward the temporal area. (Note the scar line in Figure 197 *b* p. 292)

There was no resultant traction to produce ectropion and distortion of the ala or angle of the mouth.

STAGE 3 The infra-orbital scar was dealt with by incision along the infra-orbital margin to the nose and down the attachment of the lateral nasal skin to the scar

1 This scar and normal skin were elevated laterally to the ear area.

2. Traction was applied upward and medially in a *horizontal* line. The scar was excised.

3 The skin edge was sutured to the superficial fascia on the lateral nose with fine, plain catgut, the skin closed with 0000 Dermalon.

STAGE 4 The facial skin had now been elevated sufficiently until a new hair line has been established and the scar of the temporal area eliminated. The available hair-bearing scalp bordered the scar This was utilized by transposing two Z type flaps having blood supply from the temporal, posterior auricular and occipital arteries. These flaps were rectangular in shape rather than triangular as in the classic Z incision. The principle involved is identical, however

1 The new hair was located accurately by measuring the normal side and pricking this line in the scar with a hypodermic needle dipped in methylene blue.

2. This dotted line was incised from the sagittal hair line to the zygoma, including the temporal artery The superior end of this incision was continued along the parietal hair line to the level of the ear including the posterior auricular and branches of the occipital arteries.

3 This flap was elevated from the pericranium.

4 A flap of similar width and proper length was incised in the hairy scalp over the left parietal, occipital and right parietal bones down the level of the ear canal. This flap is supplied by the temporal, posterior auricular and occipital arteries.

5 The flap was elevated from the pericranium.

6 The flaps were transposed.

7 Suture with 0000 Dermalon was effected

An interval of six to eight weeks elapsed.

STAGE 5 The hair bearing flap had been placed lower in front of the ear than normal to permit final elevation of the facial skin and the establishment of the desired hair line. Multiple excision of the transposed scar scalp now began.

1 An incision was made the length of the center of the scar The traction sutures were kept within this scar tissue until hair bearing scalp edges could be approximated.

2. The scar and adjacent normal scalp were elevated as formerly

3 Strong Dermalon traction sutures were passed to draw one cut edge of the scar under the opposite elevated scalp the maximum distance (see p 350 Fig. 236)

4 An incision was made along this line and sutured.

Similar excisions may be repeated along this line and in same manner each six

Procedure STAGE 1

1 An incision was made along the border of the remaining normal cheek skin from the attachment of the ala to the posterior attachment of the ear

2. The skin of the cheek and lateral neck was elevated by blunt or sharp dissection in the subcutaneous connective tissue above the fascia. This dissection was carried lateral to the sternomastoid muscle.

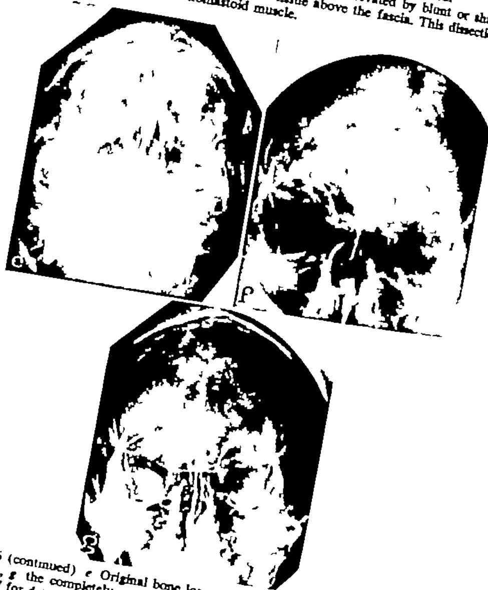


Fig. 196 (continued) *e* Original bone loss *f* the condition six weeks following bone graft, *g* the completely organized condition one year after the bone graft. (See p. 287 for detailed description and procedure.)

3 An incision was made along the entire anterior attachment of the ear and carried to the original horizontal incision.

4 This scar flap was elevated by dissection, as before. The dissection was carried mesially around the bony margin of the orbit to the lateral attachment of the nose.

5 The lower flap was elevated with sharp hooks and lapped over the scar flap to determine approximately the proper line of its excision.

6 Three or four heavy Dermalon sutures were passed through the scar above the line just previously determined, through the edge of the normal skin directly

below and then back through the scar close to the point of beginning. This suture draws the edge of the normal skin below the scarred skin and, under traction, to the maximum level or line of excision and subsequent suture without difficulty (see Meloplasty p. 350 Fig. 236)

7 Excision was done.

8. The two flaps were approximated with simple catgut sutures at intervals of 2 cm.

9 The edges were closed with 0000 Dermalon.

10 Traction was relieved with a strip of 30 mesh gauze 4 cm. wide applied to the cheek and scarred frontal area with nonflexible collodion.

An interval of six weeks elapsed.

STAGE 2. The skin was massaged or rather stretched by traction made with the ball of the thumb and first finger for several minutes three or four times daily during the latter third of this period.

1 The scar line was incised and treated as previously The upward traction draws the skin from the lateral neck and that of the submaxillary area upward toward the temporal area. (Note the scar line in Figure 197 *b* p 292)

There was no resultant traction to produce ectropion and distortion of the ala or angle of the mouth.

STAGE 3 The infra-orbital scar was dealt with by incision along the infra-orbital margin to the nose and down the attachment of the lateral nasal skin to the scar

1 This scar and normal skin were elevated laterally to the ear area.

2. Traction was applied upward and medially in a *horizontal* line. The scar was excised.

3 The skin edge was sutured to the superficial fascia on the lateral nose with fine, plain catgut, the skin closed with 0000 Dermalon.

STAGE 4 The facial skin had now been elevated sufficiently until a new hair line has been established and the scar of the temporal area eliminated. The available hair-bearing scalp bordered the scar This was utilized by transposing two Z type flaps having blood supply from the temporal, posterior auricular and occipital arteries. These flaps were rectangular in shape rather than triangular as in the classic Z incision. The principle involved is identical, however

1 The new hair was located accurately by measuring the normal side and pricking this line in the scar with a hypodermic needle dipped in methylene blue.

2. This dotted line was incised from the sagittal hair line to the zygoma, including the temporal artery The superior end of this incision was continued along the parietal hair line to the level of the ear including the posterior auricular and branches of the occipital arteries.

3 This flap was elevated from the pericranium.

4 A flap of similar width and proper length was incised in the hairy scalp over the left parietal, occipital and right parietal bones down the level of the ear canal. This flap is supplied by the temporal, posterior auricular and occipital arteries.

5 The flap was elevated from the pericranium.

6 The flaps were transposed.

7 Suture with 0000 Dermalon was effected

An interval of six to eight weeks elapsed.

STAGE 5 The hair-bearing flap had been placed lower in front of the ear than normal to permit final elevation of the facial skin and the establishment of the desired hair line. Multiple excision of the transposed scar scalp now began.

1 An incision was made the length of the center of the scar The traction sutures were kept within this scar tissue until hair bearing scalp edges could be approximated.

2. The scar and adjacent normal scalp were elevated as formerly

3 Strong Dermalon traction sutures were passed to draw one cut edge of the scar under the opposite elevated scalp the maximum distance (see p. 350 Fig. 236)

4 An incision was made along this line and sutured.

Similar excisions may be repeated along this line and in same manner each six

Procedure STAGE I

1 An incision was made along the border of the remaining normal cheek ski from the attachment of the ala to the posterior attachment of the ear

2. The skin of the cheek and lateral neck was elevated by blunt or sharp dissection in the subcutaneous connective tissue above the fascia. This dissection was carried lateral to the sternomastoid muscle.



Fig. 196 (continued) *e* Original bone loss *f* the condition six weeks following bone graft *g* the completely organized condition one year after the bone graft. (See p 287 for detailed description and procedure.)

3 An incision was made along the entire anterior attachment of the ear and carried to the original horizontal incision.

4 This scar flap was elevated by dissection, as before. The dissection was carried mesially around the bony margin of the orbit to the lateral attachment of the nose.

5 The lower flap was elevated with sharp hooks and lapped over the scar flap to determine approximately the proper line of its excision.

6 Three or four heavy Dermalon sutures were passed through the scar above the line just previously determined, through the edge of the normal skin directly

below and then back through the scar close to the point of beginning. This suture draws the edge of the normal skin below the scarred skin and, under traction, to the maximum level or line of excision and subsequent suture without difficulty (see Meloplasty p. 350 Fig. 236)

7 Excision was done.

8 The two flaps were approximated with simple catgut sutures at intervals of 2 cm.

9 The edges were closed with 0000 Dermalon.

10. Traction was relieved with a strip of 30 mesh gauze 4 cm. wide applied to the cheek and scarred frontal area with nonflexible collodion.

An interval of six weeks elapsed.

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There was no resultant traction to produce ectropion and distortion of the ala or angle of the mouth.

STAGE 3 The infra-orbital scar was dealt with by incision along the infra orbital margin to the nose and down the attachment of the lateral nasal skin to the scar

1 This scar and normal skin were elevated laterally to the ear area.

2. Traction was applied upward and medially in a *horizontal* line The scar was excised.

3 The skin edge was sutured to the superficial fascia on the lateral nose with fine, plain catgut, the skin closed with 0000 Dermalon.

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7 Suture with 0000 Dermalon was effected.

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2. The scar and adjacent normal scalp were elevated as formerly

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4 An incision was made along this line and sutured.

Similar excisions may be repeated along this line and in same manner each six

Procedure STAGE 1

1 An incision was made along the border of the remaining normal cheek skin from the attachment of the ala to the posterior attachment of the ear

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Fig. 196 (continued) *e* Original bone loss *f* the condition six weeks following bone graft *g* the completely organized condition one year after the bone graft. (*See p. 287 for detailed description and procedure.*)

3 An incision was made along the entire anterior attachment of the ear and carried to the original horizontal incision.

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5 The lower flap was elevated with sharp hooks and lapped over the scar flap to determine approximately the proper line of its excision.

6 Three or four heavy Dermalon sutures were passed through the scar above the line just previously determined, through the edge of the normal skin directly

below and then back through the scar close to the point of beginning. This suture draws the edge of the normal skin below the scarred skin and, under traction, to the maximum level or line of excision and subsequent suture without difficulty (see Meloplasty p 350 Fig. 236)

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9 The edges were closed with 0000 Dermalon.

10. Traction was relieved with a strip of 30 mesh gauze 4 cm. wide applied to the cheek and scarred frontal area with nonflexible collodion.

An interval of six weeks elapsed.

STAGE 2. The skin was massaged or rather stretched by traction made with the ball of the thumb and first finger for several minutes three or four times daily during the latter third of this period

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5 The flap was elevated from the pericranium.

6 The flaps were transposed.

7 Suture with 0000 Dermalon was effected.

An interval of six to eight weeks elapsed.

STAGE 5 The hair-bearing flap had been placed lower in front of the ear than normal to permit final elevation of the facial skin and the establishment of the desired hair line. Multiple excision of the transposed scar scalp now began.

1 An incision was made the length of the center of the scar The traction sutures were kept within this scar tissue until hair-bearing scalp edges could be approximated.

2. The scar and adjacent normal scalp were elevated as formerly

3 Strong Dermalon traction sutures were passed to draw one cut edge of the scar under the opposite elevated scalp the maximum distance (see p. 350, Fig. 236)

4 An incision was made along this line and sutured.

Similar excisions may be repeated along this line and in same manner each six

to eight weeks, if the patient pushes (moves) and massages the scalp several times daily during the latter half of this interval. Three to six such *procedures*, depending upon the width and location of the scar or graft, are usually sufficient.

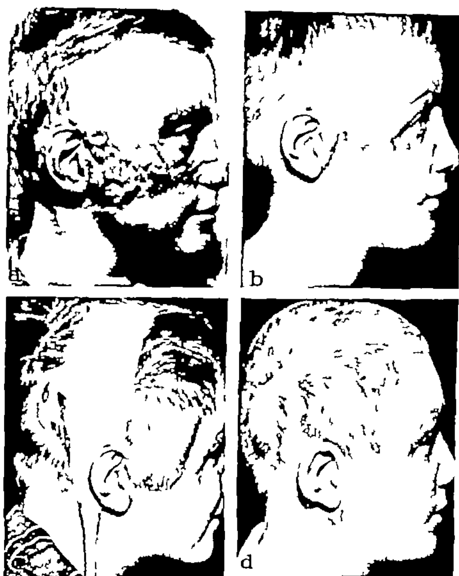


Fig. 197 Case VI large scalp loss with intact bone. *a*, The original condition, a second and third degree burn destroying the hair bearing scalp of the temporal-parietal region, skin of the upper half of the right face and neck, the helix of the ear and the eyebrow *b* The *hypertrophied facial scar replaced by normal skin from* the lower face and neck by multiple excision. *c*, The hair-bearing scalp exchanged *for the temporal scar by Z plastic* the exchanged scar tissue eliminated by multiple excision and the helix repaired with a small tubed pedicle taken from the clavicular region the eyebrow replaced by a full thickness hair bearing scalp graft. *d* The result nearing completion. (See text for detailed description and procedure.)

The tubed pedicle to repair the helix is managed during these excision procedures, beginning with the initial one. One end of the tube is elevated and sutured to a small U-shaped skin flap in the middle of the neck. Four to six weeks later the opposite end is elevated and attached to the skin over the mastoid area. After a

similar time period the former end is detached from the neck, the scar line along the tube excised, and the tube draped over the helix as desired (Fig. 197 *c d* p. 292)

STAGE 6. The eyebrow could now be grafted. The required dressing and bandaging would have interfered previously with results of the scalp surgery

A full thickness graft from the median line of the occipital was chosen (see Eyebrows, p. 281 Fig. 191)

LOSSES OF BONE AND SCALP

Losses of this type result from burns—fire chemical and electrical, accidents of transportation and industry, missiles of war and civil life They produce varying degrees of shock, hemorrhage and infection.





Fig. 198 Case I loss of bone and scalp bone necrosis. *a* Presents the original condition and outlines the procedure. *b c d* Management of the flaps.

The loss of bone may be immediate and include its total thickness. The damaging agent (electrical) may destroy the blood supply and result ultimately in sequestration of the dead structure, it may result from the heat of friction (rotating shaft) or a transportation blow that destroys the blood supply of the outer table only or it may result from flame or chemical burn with either of the above results.

Case I. Loss of Temporal-Parietal Scalp and Necrosis of the External Table of the Skull. This resulted from a transportation accident. It was necessary to remove a part of the external table (*X*) in order to provide a viable base for scalp repair The initial condition, pictured in Figure 198 *a*, is the result of several weeks of dressing after the accident. The bordering white areas, except that marked *X* are

scar epithelium. An anterior portion of the conchal cartilage was gouged out in the accident.

It was desirable to cover the area with normal scalp rather than resort to skin grafts and subsequent multiple excision to bring hairy scalp into the area. This was possible by so inching and widely freeing the scalp that it could be rotated as well as advanced.

The outer table of the area marked X was removed and granulation promoted. The granulation in the incised ear was removed and the area covered with a thin graft to provide contraction before final closure.

The reconstruction of the ear was completed after the final stage of scalp repair

Procedure STAGE 1

1 Incision was made from the remnant of the ear canal across the parietal bone to the sagittal line (*AB*) and continued along the superior border of the scar and into the bordering occipital scalp for 1 cm. (*BCD*) The posterior scalp border was incised from this line *CD* to the granulation at point *E*. The incision *AB* was extended from the point *B* in a curved line backward and downward across the midline of the right parietal bone to terminate about 2 cm. above the ear (*BF*)

The scalp posterior to the incision *EDCBF* had the posterior auricular and occipital arteries for blood supply The anterior frontal flaps depend upon the branches of the temporal arteries.

2. The flaps were freed from the pericranium by blunt dissection.

3 The right parietal occipital flap was rotated to the left. Strong traction was made from the point *C* diagonally along the midoccipital line on the right side, and from point *C'*

4 Suture from *C* to *C'* was made with 00 Dermalon.

5 A sharp hook was placed in the upper third of *AC'* at the point *G* and lapped over *CD* to the point *H* Incision was made from *C* to *H* The approximated edges were sutured from *C* to *H* and the anterior edge of the scalp split was sutured to the frontal flap from *H* toward *A*

6. The left occipital flap was advanced and sutured along the line *ID*

7 The granulation remaining in the scalp defect and ear was split skingrafted. The contraction of this thin graft made closure of the balance of the scalp possible at another stage in six to eight weeks.

Case II. Large Loss of Bone and Scalp in the Bilateral Occipital and Parietal Areas as the Result of a Burn with a 2000-Volt Current. The patient came for repair five weeks after injury The bone in the exposed area was necrotic. Its removal exposed an area of suppurative pachymeningitis (Fig. 199 p. 295)

All the normal scalp vessels were available to the border of the loss. This bordering scalp was used for reconstruction. Proper flaps must be based in either the occipital or frontal regions. The incision of suitable flaps sections the posterior auricular arteries and either the occipital or temporal arteries. Flaps supplied by the occipital arteries would have a questionable supply even after several "delays." Such flaps would result in marked frontal cosmetic disabilities.

Procedure. STAGE 1 The scalp borders were trimmed and elevated to normal bone. The necrotic bone was removed. The suppurative meningitis was treated locally with wet dressings and antibiotics.

STAGE 2.

1 The marginal borders of the defect were incised and the incision continued down the midoccipital line to produce the desired width of flaps, and anteriorly to terminate in the hair posterior to the temporal artery

2. The flaps were elevated from the pericranium from their posterior ends forward as far as good blood supply permitted, and returned to their beds and sutured.

3 This delaying procedure was repeated at two weeks intervals until the flaps could be safely rotated. This was done four times in this case.

An interval of eight weeks elapsed.

STAGE 3

1 Flaps *A* and *B* were elevated (Fig. 199) from the pericranium.

2. Flap *A* was rotated to suture its distal end to the anterior border of the defect.

3 Flap *B* was rotated under flap *A* Maximum traction was made to the left.

4 The superior edge of flap *B* was sutured to the inferior edge of flap *A* A defect remained between the lower border of flap *B* and the skin of the neck.





Fig. 199 Case II loss of cranium and scalp *Top* Loss of scalp and parietal and occipital bone exposed dura presenting suppurating granulation (suppurative pachymeningitis) *Lower left* Cleanly granulating dura exposed edges of bone delayed flaps of scalp (*AB*) for the reconstruction. *Lower right* Skull repaired with osteoperiosteal graft, defect of scalp repaired with rotated flaps *A* and *B*

5 This neck skin and subcutaneous tissue were freely undercut.

6. Elevation and suture were done.

An interval of three weeks elapsed.

STAGE 4

1 The scalp scars were opened to uncover the bony edges of the defect and separated from the dura by blunt dissection.

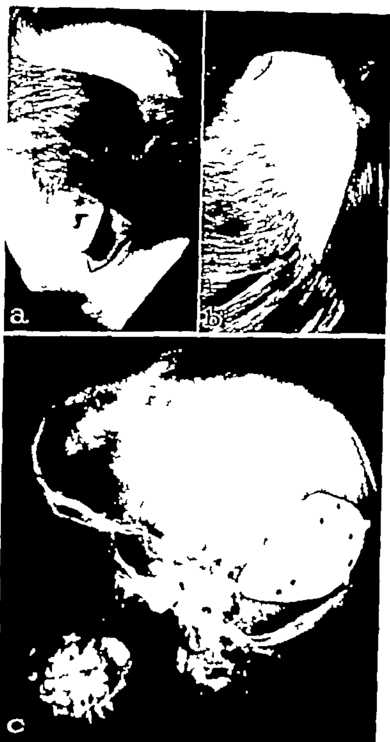


Fig. 00 Case III loss of the posterior half of the parietal and temporal bones, and of the covering scalp and the upper fourth of the ear repair with a scalp flap, skin graft, and a tantalum plate. (See detailed description on p. 297)

2. Graft was done with osteoperiosteal strips (see pp. 38 and 286)

This surgery stimulated hair follicles and caused growth on a previously bald scalp

Case III. Loss of the Posterior Half of the Parietal and Temporal Bones with the Covering Scalp and the Upper Fourth of the Ear This was caused by a shell fragment as the patient, an officer was leading a landing party The emergency care was remarkable and the subsequent management is technically excellent.

The bone defect was covered with a tantalum plate (Fig. 200 p. 296) The scalp covering for this plate was supplied by a shifted, double pedicled flap which had a temporal and occipital arterial blood supply A longitudinal incision from before backward in the bordering scalp permitted its separation from the pericranium and transposition. The created scalp defect was grafted with split skin. The incised edge of the ear and the adjacent edge of the scalp were used to cover and close a dural fistula.

The scalp and bone loss permitted a plan of management similar to that discussed in Cases I (p 293) and II (p. 295)

VITALLIUM, TANTALUM; SYNTHETIC RESINS

The author is definitely opposed to the use of vitallium tantalum, any of the synthetic resins or any other foreign substance in cranioplasty He recognizes the many excellent and spectacular accomplishments during World War II and, at the same time realizes that insufficient time has elapsed to appraise the fate of these foreign bodies. It is true that they *apparently* create no adverse tissue reaction, but many of them have already been removed in various locations.

The only foreign body that has withstood the test of years is inert, sterilized homologous cartilage. Some corneal transplants have a long history Both live in their natural state by lymph absorption and are the only homologous substances tolerated by the body

There are isolated cases of various foreign substances remaining in the body for years, they are the exceptions that prove the basic rule

There is sufficient autogenous bone to ultimately repair these defects The type and method of its use are matters of agreement with certain facts, both laboratory and clinical



Chapter VI

MELOPLASTY

The correction of disabilities, either by readjustment or reconstruction about the face and its several appendages is the most exacting and outstanding test of the plastic surgeon's ability and habit of meeting his responsibility. This is a dual one, both function and cosmesis are involved. The relative importance of these two objectives varies with the particular patient and the area involved. A large percentage of all cases are purely cosmetic in character. The proper planning and management of these various situations is frequently of vital importance to the psychic condition of the patient and his consequent behavior and accomplishment in contemporary society.

The triad of procedures most utilized about the world today—the Indian method of using forehead flaps about the face and nose, the pedicled flap from a distance, and the use of various types of free grafts—has largely replaced the well-established basic principles of local repair using tissue bordering the defect. The use of rotated, "hinged" (reflected) and specially designed sliding (advanced) flaps has become nearly a lost art.

Some procedures of great value are neither generally known nor utilized at all. The excellent accomplishments of Imre through recent years are splendid examples of some of the possibilities.

It is particularly desirable that lesions of the cheeks be repaired with normal skin from the borders whenever possible. The surgeon should adopt, invariably, a plan to accomplish this whenever he is permitted

to choose the procedure No transplanted skin, either full thickness or a split portion blends with its surroundings sufficiently to prevent the repaired area from becoming a definite cosmetic disability—the most noticeable feature of the face This is true not only of the ideal examples of such results but distressingly so in many ordinary instances. It is possible for the female patient to mask such defects with various types of "makeup but this is hardly desirable for a man in any capacity

Proper planning of repair precludes the adding of a single unnecessary scar or foreign tissue to any visible part of the body



Fig. 201 Muscles of expression and arteries. *1 2 3* Heads of musculus quadratus labii superioris, respectively as follows angular head infra-orbital head, zygomatic head *4* angular artery *5* musculus caninus, *6* musculus orbicularis oris *7* musculus zygomaticus, *8* musculus buccinator *9* musculus triangularis *10* facial artery *11* musculus quadratus labii inferioris (inferior labial artery) *12* Stensen s duct. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

All the required materials for repair are available in the patient s body and their use, with two exceptions—cartilage and cornea—is vital to a successful outcome

The necessity and value of a proper supporting framework is universally recognized the anatomic and physiological principles in providing it have long since been established by observation of trial and error These basic principles are not universally followed today All types of foreign substances have been advocated and discarded through the centuries yet new and old ones continue to be introduced. The surgeon frequently refuses to recognize the fate of these foreign bodies (see p 297)

It is desirable to consider superficial losses of the skin and mucosa, losses involving the skin and muscle only and losses which involve all the elements of the cheek. To this end a clear picture of the under lying muscles is essential (Fig. 201) (See Undesirable Procedures, p 250)

LOSSES OF SKIN

Small defects can be repaired by sufficient undercutting and sliding of the bordering skin or by utilization of carefully planned, rotated flaps (Figs. 276 277) Large defects can be covered with *thick split skin*, or *full thickness skin grafts* or by the use of *pedicled flaps* from the vicinity or from a distance. Such repairs should be considered temporary when ever the surrounding normal skin will permit ultimate removal of the transplant by multiple excision

LOSS OF LINING

Superficial losses of *mucous membrane* if not too large can be re paired by sliding the bordering tissue by the use of pedicled flaps rotated from the vicinity or by the use of Esser Waldron inlay technic (Fig. 287)

Esser Waldon Inlay Esser's technic consists in dissecting out the scar undermining the edges of the bordering tissue making a mold of dental modelling compound to fit the defect, covering this with split skin raw surface outward, and inserting and suturing this covered mold in the defect, to remain there for ten days The edges of the mucosa are closed over the mold with horsehair sutures A skin graft of this type will not control the contraction of new fibrous tissue

A large loss of mucosa demands different management. Skin must be introduced from a distance on a pedicled flap This pedicled flap should be introduced through an incision which will leave the least de forming scar Such an area would extend along the inferior margin of the mandible, from the crossing of the facial artery to the mental fora men The pedicle may carry the flap through the mouth without external incision and scar (Figs 38 39 203)

The scar tissue is completely dissected the mouth supported in "open bite" and the pedicled flap approximated to the borders of the defect with interrupted sutures.

The pedicle is amputated after three weeks and the edge of the flap adjusted in the cheek. The margins of the cutaneous opening along the jaw are pared and the skin is closed with interrupted sutures.

LOSSES OF SKIN AND MUSCLE

Small losses of this type can be repaired in a manner similar to small losses of the skin with added shifting of underlying fat and the subsequent addition of supporting material (dermal graft) if required. Large losses are best repaired with rotated interpolated flaps carrying fat from the borders of the defect or from beneath the mandible (see

Figs 242, 247, 439) If such skin is not available or desirable, a pedicled flap from the lower neck provides good surface matching. This can be supplemented later with additional supporting material for example, dermal graft, and so on.

LOSSES OF FULL THICKNESS OF CHEEK

Losses of the entire thickness of the cheek which are too large for simple suture can be repaired by several useful and available combinations. *In all cases a proper epithelial lining of either mucosa or skin must be supplied*

Operation for Small Defects. Small losses too large for the edges of the defects to be approximated and sutured without deformity can be repaired by suturing the bordering skin to the bordering mucosal lining of the defect in a manner to obtain the finest scar and the maximal blood supply at the point of union. This line of union will be utilized later as the base of a hinged flap of skin to repair the lining defect

Procedure Shave the area of skin to be utilized as the lining flap with a skin-graft razor, cutting sufficiently deep to destroy the hair follicles, and cover it with a thick split skin graft. Elevate and delay this flap, after complete organization of the graft, until it enjoys an adequate blood supply Split the mucosa from the skin around the margins of the defect, except at the line of its attachment of the mucosa to the prepared skin flap Dissect and suture the skin flap to this mucosal edge of the defect (Fig 435, *d A*) Close the skin defect, whenever possible, with a carefully planned sliding or rotated flap This results in a covering skin of normal appearance. Such depression as results from loss of the intervening muscle and fat is subsequently corrected with dermal graft (see p 135)

Pedicled Flap for Large Defects. A pedicled flap from a distance becomes a necessity if the defect is too large to permit utilization of the surrounding skin for closure This flap can be used in several manners (1) It may be folded upon itself to provide skin on either surface, or its raw surface may be skin grafted before its use. (2) The pedicled flap can be sutured to the defective mucosal border until an adequate new blood supply has been gained, and then the pedicled flap can be covered with a part of the pedicle which is folded over the implanted lining. (3) A pedicled flap may replace the entire muscle and lining of the cheek and can be covered by the skin from the cheek.

The introduced skin rarely matches the normal surrounding skin It may be removed, after thorough organization, by multiple excision It is frequently possible to supply the covering by free grafting. These grafts merit the same criticism as the pedicled flap and can be treated subsequently in a similar manner

CICATRICIAL CONTRACTION

Restoration of Function. Contraction caused by scar of any or all of the elements of the cheek or muscles attached to the mandible may pro-

duce limitation of motion varying from slight disability to complete fixation

Waldron's application of Esser's technic produces satisfactory results in those cases wherein the limitation of motion is moderate and depends on scar in the mucosa and underlying muscle New tissue from a distance must be introduced in cases where the destruction has been more widespread. There is considerable muscular atrophy from disuse if the fixation is of long duration

The management should be so planned that the nerve supply and remaining musculature are preserved in order to restore function together with that of the mandible

Procedure STAGE 1 Incise the skin from a point 1 inch (2 5 cm) above the angle of the jaw down to the margin of the mandible along the inferior margin of the mandible to the mental symphysis, and curve the incision upward to divide the lower lip Dissect the skin and underlying fat upward for 1 inch or more above the margin of the jaw

Incise the buccinator muscle and scarred mucosa along a line parallel to and about ½ inch (about 1.3 cm.) above its attachment to the jaw Dissect out any retaining scar Avoid injury to the middle and lower branches of the facial nerve and to Stensen's duct. The muscle and scar remaining attached to the mandible provide an abutment for the reparative flap which is to be introduced. Fix the jaw in "open bite" Suture the free distal margins of the pedicled flap from the arm to the incised muscle and lining borders Suture the elevated skin flap over the raw surface of the introduced pedicled flap (Fig. 203)

An interval of three weeks is allowed to elapse before Stage 2

STAGE 2 Amputate the pedicle of the flap and adjust the cut margin of the flap and facial skin covering If the facial skin is involved in the contracture it can be repaired by utilizing skin from the pedicle of the lining flap at this stage

RETRACTED ADHERENT SCAR. CONTRACTURE OF ORAL OPENING

The condition illustrated in Figure 202 followed compound comminuted fracture of the maxilla and the right malar bone with subsequent infection and late reduction of fractures.

Disability The skin and musculature of the face are adherent to the periosteal covering producing a retracted, fixed scar as a result of improper primary repair

Requirements. Readjustment, without introduction of new tissue

Procedure. There are several procedures for correction of this type of disability (p 209) The procedure of choice is as follows

Incise about the borders of the scar at right angles to the surface of the skin with a sharp knife and undercut the bordering skin (p 212) Pare the epithelial surface from the scar leaving its bed undisturbed. Slide the bordering skin over this remaining scar bed and ap-

proximate with horizontal mattress sutures. Apply a dressing of gauze moistened with 70 per cent alcohol. Remove the sutures on the second day and support with 30-mesh gauze strips applied with collodion.



Fig. 202. Poulard's operation (p. 212) *a* and *b* Contracted, adherent scars of the cheeks; contracture of oral opening: *c* and *d* appearance after repair

The skin can be approximated with a subcuticular stitch which is either absorbable or of material which is removed at the end of ten to twelve days. In either event, the new line of union must be supported until its organization and softening are complete.

Other methods of dealing with contracted scar are detailed on page 209

LOSS OF MUSCLE AND LINING

The circumstances in one case are represented in Figure 203

Requirements. New epithelial lining to replace the entire mucosa of the cheek from the superior fornix to the mandible and soft supporting tissue to replace the loss of muscle for cosmetic appearance

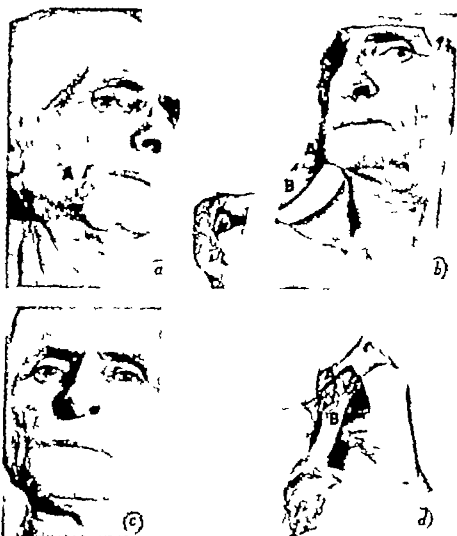


Fig. 203 Loss of lining and musculature of cheek. *a* and *c* Appearance of patient after reconstruction of the mucous-membrane lining and musculature of the cheek, *b* tubed pedicle from the arm, carrying a skin flap and fat for the repair fixation of head and shoulder with a plaster dressing *d* tubed pedicle flap *B* skin flap from cheek, *A* (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Procedure *Stage* 1 Make an incision from the angle of the jaw along the line of the mandible to the region of the mental foramen and upward to a point just lateral to the angle of the mouth Dissect all scar and involved tissue

Elevate and rotate a previously prepared pedicled flap (*B* in Fig

203) on the arm to present its skin surface mesially and its raw surface externally (Fig. 203, *d*) This flap carries with it all the available fat. Approximate its free margins to the borders of the mucosal and muscular defect with interrupted sutures

Approximate the skin flap *A* to the raw surface of the pedicled flap *B* and stitch its margins to the margins of the defect in the cheek with interrupted sutures

A period of three weeks intervenes between Stages 1 and 2

Stage 2 Amputate the pedicle *B* Dissect the skin covering *A* free from the margins of the lining flap Adjust the incised edge of the flap to the lining defect. Pare the margin of the skin covering *A* and approximate it to the edge of the defect in the cheek with interrupted sutures Apply a gauze dressing saturated with alcohol. *Adjust the base of the* pedicle *B* on the shoulder and approximate it with interrupted sutures

SALIVARY FISTULA (FISTULA OF STENSEN'S DUCT)

The method of management depends on the location of the fistula

Fistulous Opening Anterior to Anterior Border of Masseter Muscle (Fig. 204 *a A*) This fistula can be repaired readily by following a modification of Langenbeck's technic. He passed a probe into the duct through the fistula and dissected the duct free from its surroundings. The duct was then drawn through a bluntly dissected tract in the buccinator muscle and sutured to the buccal mucosa.

Procedure It is somewhat easier and considerably more certain to raise a *disk of skin* about ⅜ inch (about 1 cm) in diameter about the fistulous opening and dissect this free with the attached duct (Fig. 204 *a A*) Four horsehair sutures armed with a curved needle on each end are passed through quadrants of this disk of skin. These are used to draw the disk through a bluntly dissected tract in the buccinator muscle and buccal mucosa. The stitches are passed through the mucosa to approximate it to the margins of the disk. The circular defect in the skin is elongated by removal of a triangular piece at the opposite ends of its horizontal diameter the surrounding skin is undercut, and skin is approximated with interrupted horsehair sutures.

Fistulous Opening at Anterior Edge of Parotid Gland or between It and Anterior Margin of Masseter Muscle. This can be repaired satisfactorily by either of two procedures

Braun's Operation Incise the skin and superficial fascia from a point just posterior to the fistulous opening to a point about ¾ inch (about 2 cm) anterior to the border of the masseter muscle. Reflect these flaps from the muscle Incise a mucous-membrane flap of the desired length and width with its base at the margin of the masseter muscle (Fig. 204 *e f D*) Separate the fibers of the buccinator muscle just anterior to the masseter muscle and draw the mucous-membrane flap through it. Approximate the raw edges of the flap with interrupted sutures of 00000 plain catgut and approximate the end of the flap to the free end of the duct (Fig 204 *e f*) The *E* in Figure 204 *e f*

represents the stump of Stensen's duct. Close the incision in the skin with interrupted sutures of horsehair. Undercut the edges of the defect in the buccal mucosa and approximate with interrupted sutures.

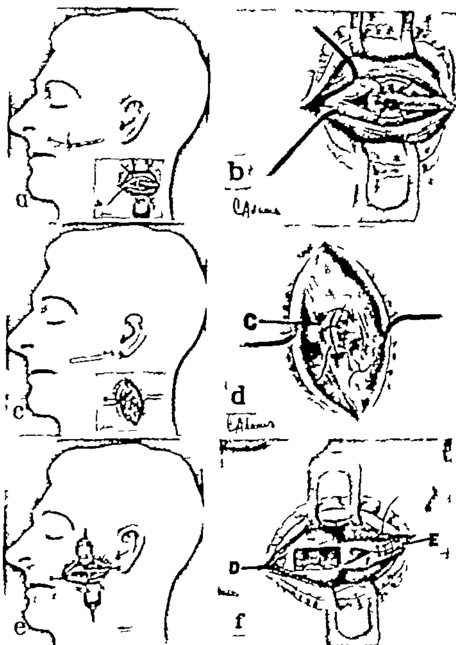


Fig. 204 Salivary fistula in the cheek. *a* and *b* Smith's modification of Langenbeck operation, *c* and *d* fistula over masseter muscle or at its border (Smith's operation) *e* and *f* fistula between border of gland and edge of masseter muscle (Braun's operation) Letters which appear on the face of the drawing are explained in the text.

Author's Method. The purpose of this method is to create an epithelial lined tract through the buccinator muscle and buccal mucosa and to connect this tract with a fistulous opening.

STAGE 1 Make a vertical incision ⅝ inch (about 1 6 cm.) long just anterior to the fistulous opening Dissect bluntly a tract beneath the skin to the edge of the masseter muscle and through the buccinator muscle to the *mucosa* at the normal outlet of the duct Insert a glass rod ¼ inch (about 0 6 cm) in diameter and with rounded ends, covered with thick split skin raw surface outward The skin is best applied by folding a long narrow strip over the end of the rod and approximating the edges of the strip with a few fine catgut sutures to form a sac (Fig 204 *c B*) Close the skin incision with two or three interrupted sutures. Apply a gauze pad with adhesive tape over the area.

STAGE 2 This stage is performed ten days after performance of Stage 1

Incise the buccal mucosa over the end of the glass rod Reopen the skin incision and remove the rod. Replace it with a second rod which is longer than the tract. The ends of this rod project slightly through the buccal mucosa and through the skin Epithelization of the orifices and contraction occur while the rod is in position It may be removed daily or at longer intervals for cleansing, if this is indicated. Circular skin flaps are raised around the fistulous opening and the opening of the new tract The epithelial surfaces of these disks are scraped or shaved with a sharp knife They are then approximated and fine catgut sutures passed through quadrants of their peripheries (Fig. 204 *d C*) The surrounding skin is undercut and closed by sliding. This leaves a small facial scar and produces a functioning duct

LACERATIONS

Lacerations of the facial soft parts including skin covering, muscle vessels, gland ducts motor nerves, mucosa and fractured bony frame work, should be repaired immediately within the first eight or ten hours after injury if the patient's general condition permits All bleeding at least, should be stopped the wound thoroughly cleansed with saline and detergent solutions generally closed with several loose, widely separated stitches and a proper dressing until the patient s condition permits definitive treatment. Such repair may be properly undertaken after longer periods following injury depending upon its nature and so forth This statement is predicated on proper cleansing, the use of antibiotics, and so on

Case 1. Laceration of the Scalp and Face, Zygomatic Fracture and Severed Branches of the Facial Nerve. The laceration began at the vertex of the skull extended down in front of the left ear and over the body of the mandible to the chin. The parotid gland was incised The three upper branches of the seventh nerve were severed. The zygomatic arch was fractured and elevated with the lacerated scalp flap

Procedure. STAGE 1. The wound was thoroughly cleansed with saline flushing and detergent solution. All bleeding was controlled.

STAGE 2.

1 The facial nerve was examined with a faradic current. The upper three branches were severed in this instance.

The distal end of each severed nerve was located with the faradic current. Each severed nerve was approximated with a single suture of 000000 linen.

2. The zygomatic fracture was reduced. The approximating ends were drilled. A suture of chromic 0 catgut was passed through the holes at both ends, and tied.
3 The soft tissues were closed with plain 0000 catgut.
4 A few approximation sutures of catgut were passed in the dermal layer of the skin, and its surface was closed with interrupted sutures of 0000 Dermalon (Fig. 205 *b*)

The patient's healed condition at the time of his discharge is seen in Figure 205 *c*. The effort to close the lids, wrinkle the nose and retract the lip commissures



Fig. 205 Case I laceration of the scalp and face zygomatic fracture and severed branches of the facial nerve. *a*, Extent of the laceration, *b* the immediate closed condition of the laceration *c* the healed condition at the time of discharge there is paralysis of the entire left side. *d* The condition two years later the middle nerve branch has regenerated there is no function in the upper two branches. *e* The condition two years after *d*. there is regeneration and complete function on the entire left side. (See p 307 for a detailed description and the procedure.)

demonstrates the lost function in the repaired upper nerve branches. The same effort two years later is pictured in Figure 205 *d* The middle branch of the nerve has regenerated without any improvement in the two upper branches.

Case II. Laceration of the Left Face from the Zygomatic Arch to the Midcervical Region; Fracture of the Zygomatic Arch in Three Fragments with Marked Displacement; Complete Severance of the Parotid Duct at the Gland Pelvis Section of the Branches of the Facial Nerve Supplying the Quadratus Muscle Group; Laceration and Contusion of the Parotid Gland; Partial Loss of the Masseter Muscle; Fracture of the Acetabulum with Laceration of the Anterior Wall of the Auditory Canal (Fig. 206, *a*, p 309) *This situation resulted from the explosion of a cylinder during the process of welding it.*

The surgical treatment consisted in reduction and wiring the zygomatic fractures, repair of the parotid (Stensen's) duct, repair of the facial nerve, débridement and repair of the skin, and later (four months) repair of a stenosis of the ear canal

Procedure STAGE 1

1 The displaced *zygomatic fracture fragments* were elevated and drilled for suture.

2. Number 24 stainless steel wire was passed through the holes in the malar and the approximating zygoma, through the posterior end of this and the middle fragment, and through its posterior end and the anterior end of the temporal abutment. The latter was fractured but retained in position The wires were tied by twisting.

3 The parotid duct was repaired. A fine probe was passed through the buccal opening and the distal end of the duct (see Fig. 206 *a*) The lacerated pelvis of the gland was identified The duct was approximated and fixed with interrupted fine silk sutures.

4 Search was made for the distal ends of the severed upper branches of the seventh nerve, using a faradic current stimulator The distal end of the nerve supply of the muscles about the mouth was identified in this instance. The proximal part could not be identified per se. Anastomosis was attempted by identifying analogous structures on both sides of the laceration which appeared to be adjacent to the proximal and distal nerve segments.

5 A piece of silkworm gut suture was substituted as a stylus for the probe, and fixed in place with a suture in the mucosa.

6 The soft structures were approximated with 0000 plain catgut and the skin with 0000 Dermalon.

7 A Penrose drain was inserted at the parotid laceration. Furacin gauze and a fluffed gauze pressure dressing were applied.

Note Figure 206, *b* and *c* The upper nerve branches appear to have failed to regenerate. Action of the other muscles of expression is satisfactory The parotid duct is patent and functions.

An interval of four months elapsed before Stage 2.

STAGE 2. REPAIR OF THE AUDITORY CANAL. Healing of the lacerations resulted in occlusion of the canal.

1 A horizontal and vertical incision was made, running from the periphery through the center of the occluding scar The four resulting flaps based on the periphery externally were reflected.

2. The scar between these flaps and the mesial occluding membrane was dissected. Three flaps were incised in a manner similar to the above so that they interdigitated with the external flaps around the periphery of the canal.

A light packing of Furacin gauze was applied.

FACIAL PALSY

Nerve Injury and Repair Paresis or total paralysis in the distribution of the facial nerve may result from one of the following (1) surrounding infection (2) refrigeration or toxemia (Bell's palsy) (3) injury to the nerve without loss of substance (4) section of the nerve, and (5) loss of substance.

The lesion may occur intracranially in a manner that precludes repair It may occur in the course of the seventh cranial nerve through its bony canal or in the soft tissues. The ultimate management of the latter two occurrences is identical but the reaction of the nerve to injury and infection in the two locations differs materially

The reaction to compression, injury to the sheath or to the sheath and some of the neurons is cellular and vascular and constitutes a vicious circle The process is more rapid within the confines of a bony passage (canal or foramen)

The first evidence of weakness in muscular tone or action calls for investigation Test the response to faradic current Definite evidence of decrease in this response is an indication for investigation of the site of injury *Make this test daily* until the issue is settled. Remember that *faradic current acts through the nerve only*

The *immediate management* in those cases in which there is section or loss of nerve substance depends on the general condition of the casualty It is desirable, but may not be expedient, to effect immediate repair

Response to faradic stimulation is lost in the distal segment of the nerve in forty-eight hours after section The presence of this reaction is a great aid in locating and following the nerve The nerve is located by dissection only after loss of this reaction

Surrounding Infection A nerve with an unbroken sheath resists pus for long periods Treatment is as follows Drain and clean up the infection. Slit the nerve sheath freely proximal and distal to the lesion Dress open with saline solution *Do not use antiseptic substances* at this stage

Refrigeration or Toxemia (*Bell's Palsy*) In approximately 80 per cent of these cases function is recovered without any interference In cases in which recovery occurs, the response to faradic current is never lost. In the other cases (20 per cent) this response is lost within a few days. If improvement does not appear in three to four weeks, operation should be performed Measures are as follows

Prepare scrupulously Irrigate the ear canal with hydrogen peroxide Dry Paint with 3 per cent iodine and remove with alcohol. Employ the usual external preparation Proceed as in Injury without Loss of Substance in a clean case

Injury without Loss of Substance Decrease or loss of faradic response is one manifestation Such injury may result from compression and crushing and from the neighboring passage of high velocity missiles

INJURY TO NERVE IN BONY PASSAGE (CANAL OR FORAMEN) This procedure requires a competent otologic or neurologic surgeon The nerve may be further injured during exposure by an inexperienced surgeon

Make scrupulous preparation including that of the ear canal. Expose the injured nerve immediately if other conditions permit, to determine whether compression only or *injury or section* has occurred. Locate and use the digastric groove as a guide to the stylomastoid foramen Remove sufficient mastoid cortex and cellular content to expose the horizontal semicircular canal A line from this canal to the *foramen* marks the course of the nerve

Begin removal of bone with rongeurs small chisels, and curets Start at the foramen and work upward to the lesion. Decompress Slit the sheath freely above and below the lesion Cover the open canal with a piece of fresh muscle if the field is clean. Close the wound without drainage

If the area is infected, dress open daily with *saline solution Do not use antiseptic* substances.

INJURY TO NERVE IN SOFT PARTS If the injury occurs between the *stylomastoid foramen* and the anterior border of the *parotid gland* proceed as follows Locate and use the digastric groove as a guide to the stylomastoid foramen Follow the nerve to or into the parotid gland until the lesion is located. Decompress. Slit the sheath freely both proximal and distal to the lesion This may be difficult or impossible to accomplish with reference to some of the smaller branches of the nerve web in the gland Close the gland with fine plain catgut. Close the wound without drainage, if clean

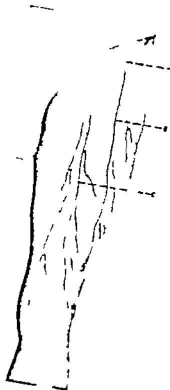


Fig. 207 Anatomic location of the anterior and lateral femoral cutaneous nerves. *A* Inguinal ligament *B* lateral femoral cutaneous nerve *C* anterior femoral cutaneous nerve.

INJURY TO NERVE DISTAL TO GLAND Locate the involved branches with the faradic current if any response persists otherwise by careful dissection Proceed as before

Section of Nerve If the break in continuity has occurred sharply cleanly and without laceration or crushing (stab wounds and so forth) the ends may be approximated by placing two or three fine sutures in the sheath

Suture is not required in the bony canal if the ends are in approximation In such a case cover the point of approximation with a piece of clean muscle or permit a blood clot to form over it Avoid the presence of *blood during the approximation* of the two ends

If laceration or crushing has occurred, the injured part should be ex

cised. If the loss is slight, the ends may still be approximated by freeing the nerve in its bed from the horizontal canal to the stylomastoid foramen If loss is sufficient to preclude suture proceed as under Loss of Substance.

Loss of Substance Loss of nerve substance preventing suture of the proximal and distal ends requires introduction of new nerve tissue Any nerve may be used but one should be chosen, removal of a piece of which will *not materially upset function* elsewhere Such a nerve should be readily accessible and obtainable in any required length. A most suitable nerve for the purpose is the lateral femoral cutaneous. This is readily located on the anterolateral surface of the thigh about 4 inches (about 10 cm) below the inguinal ligament (Poupart's) and above the superficial layer of the deep fascia (Fig. 207)

RATIONALE OF METHOD The distal end of a severed nerve undergoes wallerian degeneration in which the active cells are broken down and the detritus is removed by circulation, leaving empty tubules. The process requires about three weeks for completion It was the general belief that neurons from the proximal end grew into the empty tubules when degeneration was completed

Duel assumed in 1932 that recovery should be shortened if the implanted segment degenerated before transplantation and simultaneously with the process in the distal segment of the nerve It has been the common practice to isolate a segment of sensory nerve and allow it to degenerate before transplantation L. H. Bently of London proved that few neurons pass through the tubules. They pass along the outside of the sheath of the distal segment to the ends of its branches Consequently it was believed that the *grafting could be done immediately* This has proved true in many cases.

PROCEDURE. The ends of the proximal and distal segments are excised squarely in normal nerve tissue A section of proper length is taken from the lateral femoral cutaneous nerve. Ends of this section are approximated squarely to the cut ends of the segments These ends are sutured to maintain contact, if the injury occurs in the soft parts They are covered without suture, with fresh muscular tissue or blood clot in the bony canal.

Postoperative Course The patient and the surgeon must not be discouraged if early evidence of success is lacking. A satisfactory result has been noted in a case in which evidence of regeneration did not appear until the sixteenth month further reactivation of the orbicularis oculi and quadratus muscle groups has been noted as early as the third month. Action of these groups is frequently the first to appear It becomes associated with muscular action about the mouth and may remain so associated for many weeks before dissociation occurs The process of regeneration results in a new distribution in the muscles which apparently does not follow the original pattern. (*New and differently located end plates apparently occur*)

Stimulation with *galvanic current* (interrupted anodal closure) for

a few minutes once or twice a week should be continued until recovery has become complete (Fig. 208)

Muscular Reanimation and Fascial Support. Some nerve injuries are such in location or extent that repair is either impossible or impracticable The surgeon must find some other means of restoring function or at least, of masking the loss on the paralyzed side He may resort to either of two procedures. One offers the possibility of restoration of action by *implanting functioning muscle* from the neighborhood The nerves from this implant grow into the paralyzed muscle and "reani-



Fig. 208 Facial palsy *a*, Before nerve graft length of graft, 16 mm. *b* appearance of patient three years later (Thomas G Tickle)

mate" it. It is asserted that its purpose is accomplished in approximately 40 per cent of cases. The other method consists in *implanting fixed supports* (fascia) in the paralyzed muscles and across the midline around the lips into the functioning muscle This is intended to maintain a balanced face and mouth during action of the normal muscles of expression (Figs. 209 210)

Lexer probably first attempted the muscle balancing method. He *sectioned the anterior half of the masseter* at its insertion divided its free end and sutured one portion in each of the upper and lower lips He utilized an anterior bundle of the temporal muscle in a similar manner on the upper and lower lids Morestin approached the masseter and facial muscles through an incision along the angle and lower mar

lower lid as described previously and draw the free end of the fascial strip into the temporal incision (Fig. 209 *lower left E*)

Cross the strips (Fig 209 *lower left E F*) and interlace them into the remaining temporal muscle Make traction on the ends to get the desired support in the lids Pass sutures through the fascia and the un

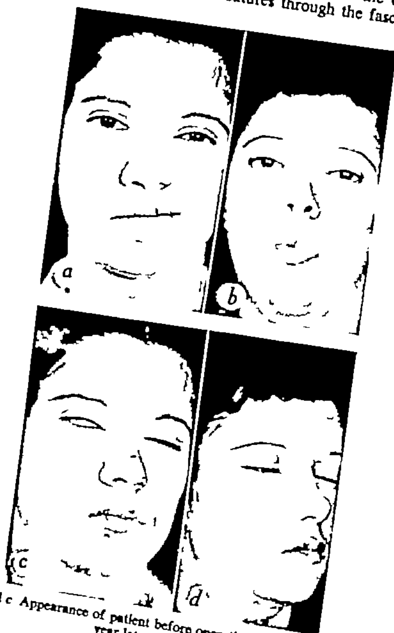


Fig. 210 *a* and *c* Appearance of patient before operation, *b* and *d* appearance one year later (Sheehan)

derlying muscle at the point of crossing and through it and the temporal muscle as the fascia is woven through it (Fig. 209 *lower left E*) Close without drainage.

Reanimation and Support of Frontalis Muscle This transplantation is made when there has been functional result from the other procedures

gin of the mandible in 1915 Brunner in 1926 reported the intra-oral approach to avoid additional scarring of the face.

Bunnell (1937) used both temporal and masseter muscle bundles prolonged by fascial strips into the attachments of the paralyzed muscles of the lids, face and mouth.

Reanimation and Support of Muscles of Expression (Face Mouth and so on) This is undertaken after the region of operation about the eye has become thoroughly organized (four to six weeks) Parts of the masseter muscle are used for this procedure

PROCEDURE Incise through the skin and platysma muscle along the lower border of the mandible. Retract the skin and muscle to expose the masseter muscle and the muscles about the angle of the mouth (Fig. 209, *lower right A*)

Segregate the anterior half of the masseter muscle and incise its attachment to the mandible. Insert the anterior strip into the junction of the angular and infra-orbital heads of the quadratus labii superioris muscle group Suture (Fig. 209 *lower right B*) Insert the median strip into the zygomatic muscle at the angle of the mouth Suture (Fig. 209 *lower right C*) Insert the posterior strip into the fibers of the orbicularis oris as they curve downward from the angle of the mouth around the lower lip Suture (Fig. 209 *lower right D*) Close without drainage.

Reanimation and Support of Eyelids (Lagophthalmos) Make a curvilinear incision over the midpart of the temporal muscle so that the incision terminates inferior to the zygoma at a point about ½ inch (1 27 cm.) lateral to the external canthus Reflect the flap forward to expose the temporal fascia (Fig. 209 *top*) Incise the skin over the medial palpebral ligament. Separate the muscle and isolate the ligament (Fig 209 *top C*) Remove enough of the superior border of the malar bone with rongeur forceps to permit free passage of temporal muscle strips to the eyelids. *Smooth* the cut surface of the bone (Fig. 209 *top A*)

Divide the anterior part of the temporal fascia and muscle into three equal strips (Fig. 209 *lower left A B C*) Implant the anterior temporal strip in the outer third of the orbicularis oculi muscle in the lower lid. Suture Implant the middle temporal strip in the upper lid in a similar manner Suture. Implant the posterior temporal strip in the outer margin of the frontalis muscle in a similar manner Suture.

Pass a large Reverdin or Blair needle beneath the skin of the temporal incision and beneath the skin and through superficial layers of the muscle of the upper lid near its free margin, so that the needle emerges in the incision by which the median palpebral ligament was exposed (Fig. 209 *top B C*) Fasten the needle to one end of a ribbon of fascia lata 6 inches (about 15 cm.) long, which has been stripped from the thigh and draw it into the temporal incision (Fig. 209 *top D* and *lower left E*) Wrap the other end of the fascial strip once around the palpebral ligament (Fig. 209 *top D C*) Pass the needle through the

lower lid as described previously, and draw the free end of the fascial strip into the temporal incision (Fig 209 *lower left E*)

Cross the strips (Fig 209, *lower left E F*) and interlace them into the remaining temporal muscle Make traction on the ends to get the desired support in the lids Pass sutures through the fascia and the un-

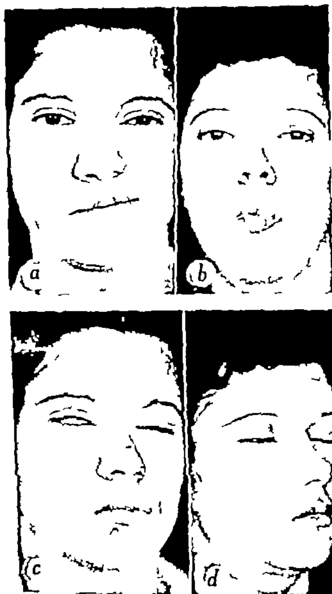


Fig. 210 *a* and *c*, Appearance of patient before operation *b* and *d* appearance one year later (Sheehan)

derlying muscle at the point of crossing and through it and the temporal muscle as the fascia is woven through it (Fig. 209 *lower left E*) Close without drainage.

Reanimation and Support of Frontalis Muscle This transplantation is made when there has been functional result from the other procedures.

Make a horizontal incision in a "line" across the middle of the f
head reflect the scalp to uncover the median edges of the fron
muscles, and transfer a strip of muscle from the median border of
functioning frontalis muscle to the inactive one

Mechanical Support—Fascial Strips. Fascia for support or ancho of paralyzed facial muscles of expression was apparently first use Busch in 1913 He passed a broad strip around the muscle at the a of the mouth and sutured this with desired tension, to the elev periosteum of the maxilla. Blair, in 1926 used spliced short strip fascia lata. He passed these through tissues served by the paraly muscles then subcutaneously to fix them to the fascia above the par gland. Lodge in 1930 passed a long 5 mm strip of fascia lata f the temporal fascia around the lids and internal ligament, around orbicularis oris and attached muscles of expression and subcutaneo back to the temporal fascia. These ends were laced into the temp fascia with desired tension. Brown, in 1939 passed similar strips s cutaneously through the face, looped them around the orbicularis and attachment of other paralyzed muscles and laced the ends of e loop through both the temporal fascia and muscle This avoided added visible facial scar and provided more motion

Fischer (1928) reported the use of a plan credited to Kirsch *(1913) in which the fascial strips were laced into the fascial sheath* the masseter muscle

Owens with a considerable experience, demonstrates the lim traction of strips fixed to the muscle sheath or fascia. He anchors strips through both the fascia and a large bundle (the middle) of masseter muscle and gains much greater excursion of the strips.

This method is used to stabilize the mouth and lower end of nose during action of the muscles of expression on the normal side a *to provide some expression to the palsied side.*

The method is simple and generally efficient. The principle involv is an inelastic fixation of the paralyzed muscles to balance the tract of the opposing functioning group and to transmit some motion fr the temporal or masseter muscle Training is required to obtain disas ciated muscular movement. In this manner the face remains balan while speaking, laughing, singing, and so forth. The fascia is not a sorbed, but becomes vascularized and retains its characteristics.

The preparation and technic must be faultless Fascial transpla do not tolerate infection

Procedure A curved incision 2½ inches (about 6.5 cm) long made in the hair area over the temporal muscle The temporal fas and muscle are exposed A small incision is made in the nasolab groove beside the nasal ala A small, curved hemostat is tunneled unc *the labial muscle to withdraw one end of a fascial strip This end* incised about ³⁄₁₆ inch (about 0.5 cm) from its edge to receive t other end of the strip which is now drawn through this incision (F

211 *A D*) The loop of fascia includes the muscle bundle A Blair needle is passed from the temporal incision beneath the skin and superficial fascia, through the nasolabial incision. The free end of the fascia is engaged and the needle withdrawn (Fig 211 *D*)

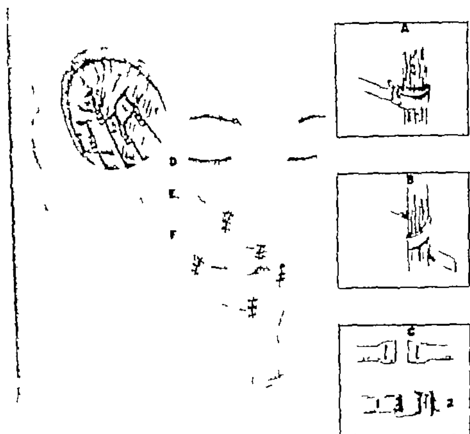


Fig. 211 Distribution and fixation of fascial strips for mechanical support of mouth and lower end of nose. *Insets*, *A* fixation of single strip around a muscle bundle *B* continuous fascial strip around a muscle bundle *C* splicing fascial strips. Letters and numbers on the face of the illustration which are not explained in the legend are accounted for in the text.

A second fascial strip is passed around the mouth and to the temporal region in the following manner A stab incision is made at the angle of the mouth on the sound side. A bundle of muscle is tunneled as described before. A long fascial strip is wrapped at its midpoint, once around the muscle bundle (Fig. 211 *B*) Stab incisions are made just lateral to the midline on the *normal* side of the upper and lower lips Muscle bundles are elevated as described previously The Blair

needle is passed from each of these incisions in turn to the incision at the angle, and an end of the fascia is drawn through. These ends are wrapped once around the elevated muscle bundles (Fig. 211 *B*) The Blair needle is now passed from the temporal incision to each of these incisions in the lip and the ends of the fascial strip are drawn out to the temporal region (Fig. 211 *E*)

A third loop of fascia is passed through the muscle about the angle of the mouth on the paralyzed side (Fig. 211 *F*) The free fascial ends are passed through the temporal fascia and muscle so as to include about ½ inch (about 1.3 cm) of muscle tissue The first part of a knot is made in the fascial strip and pulled tight enough definitely to draw the sound side medially (overcorrection) The fascia is now fixed to the muscle in this position with 00 silk. The fascia may be interlaced as shown in Figure 209 *F* Excess skin is removed, and the wound is closed without drainage

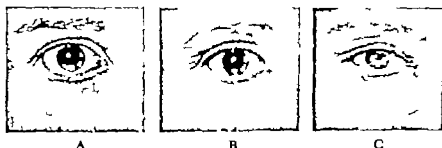


Fig. 212. Palsy of the seventh cranial nerve. *A* Original condition, *B* six months after combined fascial support of the lids and anastomosis of the seventh nerve; the improvement is the result of the fascial support, *C* condition one year later result of reestablished muscular function. (Blair and Byars Surg. Gynec. and Obst., vol. 70)

The *eyelids* (Fig. 212) are managed as explained on pages 316 and 317 (Fig. 209 *top*)

Obtaining Fascia. Strips ⅜ inch (about 1 cm.) wide are removed from the entire length of the thigh with a suitable stripper (Fig. 92) An incision 2½ inches (about 6 5 cm) long is made above the knee and the fascia is cleaned of fat as high as possible A strip of the de sired width is engaged as low as possible and is cut up to the tensor fascia femoris The required lengths of fascia (three or four strips) are removed in this manner The incision in the skin is closed without drain age and the thigh is firmly bandaged

If the fascial strips are not long enough for the purpose they can be smoothly spliced. These splices should not be made at the point of wrapping around muscle bundles (Fig. 211 *C*) Cut a slit in the ends of the two strips to be spliced. Thread the end of one strip 1 through the slit in the other 2. Now pull the free end of strip 2 through the slit in strip 1 until the two strips have become firmly engaged. Fix with 000 silk sutures.

Dressing Cover the face with fluffed gauze or sterile waste and bandage firmly Prohibit talking and other movement of the mouth. Feed through a Levin tube for one week.

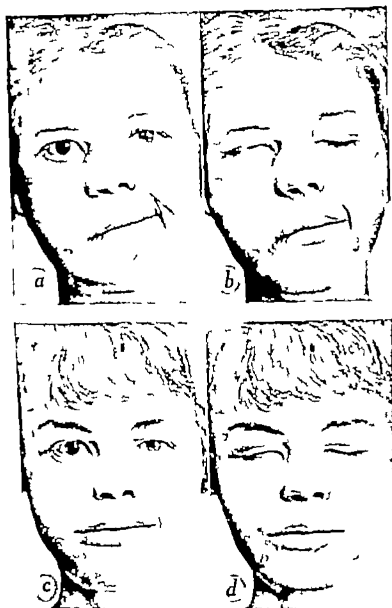


Fig. 213 Facial palsy following section of the nerve in the bone and attempted nerve suture. *a* and *b* Appearance of patient before support with fascial loops *c* and *d*, appearance of patient three months later after fixation of the paralyzed side with fascial loops. (Blair· Ann. Surg., Oct., 1930)

The face is supported and fixed after several days with gauze strips applied with collodion. These run from the side of the mouth to the temporal region. They are worn for several weeks.

Those patients in whom the masseter is used are limited in speech and in use of the mandible for three weeks. They are then advised to

use and exercise the muscle This is efficiently done by using the mirror in the effort to coordinate the muscle action

Figure 213 shows the result obtained in a case of facial palsy

Reanimation. Rosenthal expected that the motor nerves of the transplanted muscle would unite with the paralyzed nerves in the palsied muscle He obtained good action in 75 per cent of twelve cases. His reason for the restoration of nerve action could not be factual, however in view of our more recent knowledge of nerve regeneration

The author believes that the nerve grows out from the edges of the implanted active muscle in the case of active masseter and temporal bundles and forms new end plates which are differently distributed. This belief is clinical rather than based on any research with proof Several cases of suture and grafting of the main trunk of the seventh nerve in either the bony canal or before its entrance into the parotid gland as well as two cases of suture of its lacerated main branch along Stensen s duct have resulted in similar resumptions of muscular action There has been first a slight activity of the orbicularis palpebrarum and some days later a similar *associated* slight elevation of the angle of the mouth In one case the second activity was in the nasal quadratus group Extended action in these muscles occurred slowly over twelve to fifteen months. All these actions remained associated, but diminishingly so This association has never disappeared entirely over a period of years.

The author has seen two cases of masseter and temporal implants in which the muscular actions were associated.

Owens has a different conviction based upon some splendid results. He believes that reanimations occur when there is muscle traction or pull in connection with mechanical (fascia) support.

TUMORS

This discussion deals with tumors in general rather than a specific sense

It is not the author's purpose to discuss the management of the common types of malignancy Their adequate removal here as elsewhere, produces problems of reconstruction based on useful and satisfactory procedures which are dealt with elsewhere It is, on the contrary his desire to discuss briefly several benign types of pathology producing marked cosmetic disabilities and to indicate a type of satisfactory management.

Muscular Hypertrophy Overgrowth of the individual fibers and excessive growth of the number of constituent fibers of a muscle about the face—either one of the purely functional muscles or one of those of expression—is not rare How rare, it is not possible to state because of the lack of reports of such cases. Several examples have occurred in the author's experience The hypertrophy results in a marked and distressing cosmetic disability



Fig. 214 *a*, Diagrammatic illustration of incision for subdermal transplantation of masseter muscle bundles. The scalp incision for section of the anterior part of the temporal muscle and the pericanthal incision for the tunneled implantations of parts of the orbicularis oculi muscle are indicated. *b* The distribution and implantation of these muscle bundles *A* represents the approximate exit of the motor branch of the mandibular nerve.



Fig. 215 Complete facial palsy of long duration following mastoidectomy *a*, *b* and *c* present this condition *d* *e* and *f* present the reanimation following masseter and temporal muscle transplants. Dissociation exercises with a mirror have considerably improved the result.

Several instances of excessive growth in the *masseter* muscle have come to the author's attention (Fig. 216)

The management is obvious.



Fig. 216 Case I *a*, marked circumscribed hypertrophy of the masseter muscle; *b* appearance after surgical correction.



Fig. 217 Case II example of generalized hypertrophy of the masseter muscle. (See p. 322.)

Procedure

1 Make an incision below the lower border of the mandible from the posterior to the anterior attachment of the masseter

2. Reflect the skin and subcutaneous tissue from its sheath above the superior border of the mass

3 Separate the transverse facial vessels.

4 Split off by sharp dissection sufficient of the superficial layer to balance contour with the opposite side of the face Remember that the *main action is in the deep part* of the muscle

5 Suture the fascial sheath and close the incision in the soft coverings without drainage

An example of more generalized hypertrophy is seen in Figure 217 (page 324)

Hypertrophy of the orbicularis oris in either lip or its entirety produces a bad cosmetic effect. This occurs, in our experience as a part of other congenital pathology A striking example is pictured in Figure 445 (p 655)

This complicates a mixed capillary and cavernous hemangioma. The protruding lower lip was ¾ inch (1 9 cm) thick. It was believed to result from cavernous lesions until operation The muscle mass was surrounded by various vascular dilatations and was covered by a mucosa that was the site of marked capillary involvement.

The procedure was similar to that preceding with the addition of ligation of the inferior left labial artery and veins and excision of the excess mucosal covering.

Hypertrophy of the *corrugator muscle* not only creates an undesirable cosmetic disability per se but also produces marked "frown lines over the glabella and folds on either side of the frontal suture line (see Fig. 192 p 282) The course of the muscle from its origin to its scalp attachment usually creates a greater angle than normally with the orbital rim. Its stronger action than that of the frontalis through which its fibers pass to the scalp results in an entirely different course of Langer's lines. They run parallel to the eyebrow and then curve upward and inward to the median line instead of running horizontally over the frontal scalp as normally in the presence of a predominant frontalis muscle

Procedure

1 Make an incision just above the hair of the eyebrow from its mid portion to curve downward at its medial end.

2. Elevate the scalp Separate the orbicular and palpebral fibers of the orbicularis oculi muscle to locate the corrugator

3 Separate this muscle through the frontalis to its scalp attachment. Excise its entire length

4 Close the scalp without drainage

The action of these muscles of moderate size can be markedly diminished or abolished by small injections of benzyl alcohol, at intervals of six weeks until the desired result occurs.

Sebaceous Cyst. *Case III* The mass occupied the cheek from the upper to the inferior buccal sulcus. It is not fixed to the skin except at a point about opposite the second molar tooth.

The removal of the mass externally would result in a large midcheek scar—a cosmetic disability as striking as the tumor This consideration had prevented its removal for several years.

The approach was intra-oral.

PROCEDURE

1 A probe was passed into the parotid (Stensen's) duct.

2. The mucosa and fascia posterior were incised to the probe from the border of the masseter to the lower sulcus.

3 The buccinator fibers were separated from the cyst sac.

4 The cyst content was aspirated.

5 The cyst sac was separated from the vessels, duct and facial nerve. The sac was excised at the base of the skin.





Fig. 218 Case III sebaceous cyst, before and after intrabuccal removal. (See p. 325 for detailed description.)

6. The muscle was closed with 0000 plain catgut. A Penrose drain was inserted. The mucosa and fascia were closed with 0000 dermal suture or silk.

The gland in the skin continued active. It was excised three weeks later Note the skin scar (Fig. 218)

Mixed Cell Tumor with Cystic Degeneration: *Case IV* An external approach in removing a tumor of this size and distribution would necessarily result in a marked cosmetic disability It was removed intra orally by the same procedure excepting aspiration as that described in the preceding case. The tumor was not associated with the parotid gland. It involved the nerve duct, and so forth (Fig. 219)

Bilateral Papillary Cystadenoma Lymphomatosum. *Case I* The mass in the right side was 3 cm. in diameter A second separate mass under the lobe of the ear was 2 cm. in diameter Two other tumors, 1.25 cm. in diameter were found deep in front of the tragus after removal of these two larger masses.

The tumor on the left side was behind as well as below the mandible. It was 6.5 cm in diameter Both were regarded preoperatively as mixed cell salivary tumors. *The capsule of the left mass was fused with the parotid capsule.*

The procedure involved pre-auricular incisions carried around the lower borders of the tumors. The cervical branch of the seventh nerve was included in the capsule of this mass on the right side. It was separated without damage. Further removal of the tumor was accomplished in the orthodox manner

Cyst of Undetermined Origin. *Case VI* This was a fluctuating mass extending from the midhorizontal line of the cheek to 1 cm. above the clavicle below and from the anterior border of the sternomastoid muscle to within 1 cm. of the midline of the neck. Marsupialization was effected

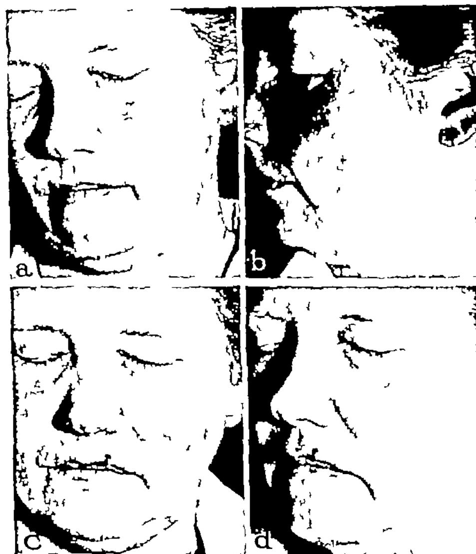


Fig. 219 Case IV mixed cell tumor with cystic degeneration, removal intra buccally *a* and *b* Present the condition, *c* and *d* after removal. (See p 326 for detailed discussion.)

PROCEDURE

1 An incision in the mucosa was made from the midmental line along the midline of the mandible to the third molar tooth.

2. The mucosa and muscle fibers were dissected from the cyst sac.

3 The cyst was aspirated, and a large amount of viscous, yellow nonpurulent fluid was removed.

4 A wide strip of the cyst sac (1½ cm. wide) was removed along the entire length of the incision.

The removal of the mass externally would result in a large midcheek scar—a cosmetic disability as striking as the tumor. This consideration had prevented its removal for several years.

The approach was intra-oral.

PROCEDURE:

1. A probe was passed into the parotid (Stensen's) duct.

2. The mucosa and fascia posterior were incised to the probe from the border of the masseter to the lower sulcus.

3. The buccinator fibers were separated from the cyst sac.

4. The cyst content was aspirated.

5. The cyst sac was separated from the vessels, duct and facial nerve. The sac was excised at the base of the skin.




Fig. 218. Case III. sebaceous cyst, before and after intrabuccal removal. (See p. 325 for detailed description.)

6. The muscle was closed with 0000 plain catgut. A Penrose drain was inserted. The mucosa and fascia were closed with 0000 dermal suture or silk.

The gland in the skin continued active. It was excised three weeks later. Note the skin scar (Fig. 218).

Mixed Cell Tumor with Cystic Degeneration: *Case II.* An external approach in removing a tumor of this size and distribution would necessarily result in a marked cosmetic disability. It was removed intraorally by the same procedure, excepting aspiration, as that described in the preceding case. The tumor was not associated with the parotid gland. It involved the nerve, duct, and so forth (Fig. 219).

Bilateral Papillary Cystadenoma Lymphomatosum. *Case V.* The mass in the right side was 3 cm. in diameter. A second separate mass under the lobe of the ear was 2 cm. in diameter. Two other tumors, 1.25 cm. in diameter, were found deep in front of the tragus after removal of these two larger masses.

The tumor on the left side was behind as well as below the mandible. It was 6.5 cm. in diameter. Both were regarded preoperatively as mixed cell salivary tumors. The capsule of the left mass was fused with the parotid capsule.

The procedure involved pre-auricular incisions carried around the lower borders of the tumors. The cervical branch of the seventh nerve was included in the capsule of this mass on the right side. It was separated without damage. Further removal of the tumor was accomplished in the orthodox manner

Cyst of Undetermined Origin. *Case VI* This was a fluctuating mass extending from the midhorizontal line of the cheek to 1 cm. above the clavicle below and from the anterior border of the sternomastoid muscle to within 1 cm. of the midline of the neck. Marsupialization was effected.



Fig. 219 Case IV mixed cell tumor with cystic degeneration, removal intra buccally *a* and *b* Present the condition *c* and *d* after removal. (See p 326 for detailed discussion.)

PROCEDURE

1 An incision in the mucosa was made from the midmental line along the midline of the mandible to the third molar tooth.

2. The mucosa and muscle fibers were dissected from the cyst sac.

3 The cyst was aspirated, and a large amount of viscous, yellow nonpurulent fluid was removed.

4 A wide strip of the cyst sac (1½ cm. wide) was removed along the entire length of the incision.

The removal of the mass externally would result in a large midcheek scar—a cosmetic disability as striking as the tumor This consideration had prevented its removal for several years.

The approach was intra-oral.

PROCEDURE

1 A probe was passed into the parotid (Stensen s) duct.

2. The mucosa and fascia posterior were incised to the probe from the border of the masseter to the lower sulcus.

3 The buccinator fibers were separated from the cyst sac.

4 The cyst content was aspirated.

5 The cyst sac was separated from the vessels, duct and facial nerve. The sac was excised at the base of the skin.



Fig. 218 Case III sebaceous cyst, before and after intrabuccal removal. (See p. 325 for detailed description.)

6 The muscle was closed with 0000 plain catgut. A Penrose drain was inserted. The mucosa and fascia were closed with 0000 dermal suture or silk.

The gland in the skin continued active. It was excised three weeks later Note the skin scar (Fig. 218)

Mixed Cell Tumor with Cystic Degeneration *Case IV* An external approach in removing a tumor of this size and distribution would necessarily result in a marked cosmetic disability It was removed intraorally by the same procedure excepting aspiration, as that described in the preceding case. The tumor was not associated with the parotid gland. It involved the nerve duct, and so forth (Fig. 219)

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The tumor on the left side was behind as well as below the mandible. It was 6.5 cm. in diameter Both were regarded preoperatively as mixed cell salivary tumors. The capsule of the left mass was fused with the parotid capsule.

The procedure involved pre-auricular incisions carried around the lower borders of the tumors. The cervical branch of the seventh nerve was included in the capsule of this mass on the right side. It was separated without damage. Further removal of the tumor was accomplished in the orthodox manner

Cyst of Undetermined Origin. *Case VI* This was a fluctuating mass extending from the midhorizontal line of the cheek to 1 cm. above the clavicle below and from the anterior border of the sternomastoid muscle to within 1 cm. of the midline of the neck. Marsupialization was effected.



Fig. 219 Case IV mixed cell tumor with cystic degeneration, removal intra buccally *a* and *b* Present the condition *c* and *d* after removal. (See p. 326 for detailed discussion.)

PROCEDURE

1 An incision in the mucosa was made from the midmental line along the midline of the mandible to the third molar tooth.

2. The mucosa and muscle fibers were dissected from the cyst sac.

3 The cyst was aspirated, and a large amount of viscous, yellow nonpurulent fluid was removed.

4 A wide strip of the cyst sac (1½ cm. wide) was removed along the entire length of the incision.



Fig. 220 Case V bilateral capillary cystadenoma lymphomatosum. (See p. 326 for detailed discussion.)

Fig. 221 Case VI cyst of undetermined origin marsupialization. *a* and *b* The original conditions c the condition after correction. (See p. 327 for detailed discussion.)

5 The borders of the sac were sutured to the borders of the buccal mucosal incision for its entire length with black silk.

This cyst was lined with well-differentiated stratified squamous epithelium. The underlying tissue was fibrous and partially muscular

There was no recurrence at the end of two years, but, at this time, a small sublingual cyst extended along the entire right oral floor

Mixed Cell Parotid Tumor *Case VII* The size of the mass is apparent. The cosmetic disturbance was the principal concern of the patient The attendant, however had a different concern because of the age of a visible mass and its recent rapid growth.



Fig. 222. Case VII *a* and *b* Mixed cell parotid tumor (See p. 329) *c* and *d* X rays of calculi in Stensen s duct.

It was removed through a pre-auricular incision from the gland and the nerve mesh in its central portion in the ordinary manner

It was histologically benign.

Ectropion (Left), Skin Atrophy and Scar Contraction, Infra-orbital Mass. *Case VIII* This patient had finished treatment by x radiation for a squamous cell infra-orbital carcinoma two months before an appearance for reconstruction.

He presented a corneal opacity a moderate ectropion, skin atrophy and an infra-orbital tumor mass 0.8 cm. in diameter He had hair bearing skin bordering the atrophic area.

PROCEDURE

1 The lid skin was incised along the orbital margin. The scar was dissected, making traction on the lid.

2. The atrophic skin, which had an adequate border around the mass, was excised.

3 The tumor mass was sectioned.

4 An adequate, rectangular flap of hairless temporal skin was incised, with rotation and interpolation in the infra-orbital defect.

5 Suture was made with 00000 Dermalon.

6 The sutures were removed on the second day and supported with strips of 30 mesh gauze applied with collodion (U.S.P)

The residual tumor mass was a benign adenoma sebaceum.

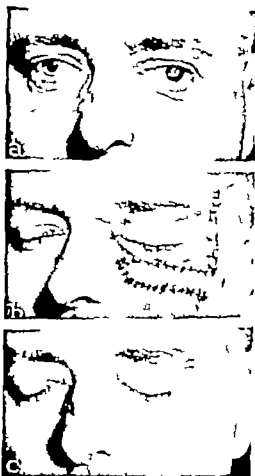


Fig. 223 Case VIII infra-orbital mass, skin atrophy and scar contraction and ectropion of the left lower lid following x-radiation for a squamous cell infra-orbital carcinoma a, Appearance after excision b repair c the finished result of this procedure. (See detailed description on p 329)

Lupus. We have for years regarded lupus as a local malignancy which spreads by continuity and rarely by metastasis. We have believed and in many cases been justified that its wide excision and removal to the fascial level with the introduction of apparently normal bordering skin would produce the desired result. This procedure may be supplemented by x radiation to deal with bordering lymphatic involvement, if indicated. We recognize the value of treatment with quartz light, radiation iodine and so forth, and at the same time the greater economic, cosmetic and consequent social value of radical excision and reconstruction.

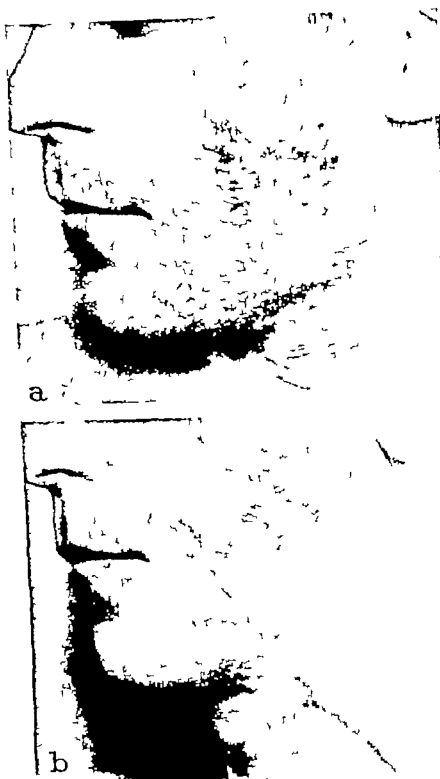


Fig. 224 Case IX. lupus of the facial skin excision and advancement of a cervical flap. The appearance (*a*) before and (*b*) after management. (See p 330 for details.)

Case IX This patient, aged 30 years, had initial treatment with x-radiation and radium at the age of nine. He has been treated at intervals subsequently He was first examined and a biopsy specimen taken two years before he appeared with a demonstrable active lesion (Fig. 224 *a*, p. 331)

PROCEDURE

1 An incision was made to the superficial fascia widely around the lesion (¾ inch, 2 cm.)

2. The skin and subcutaneous tissue were elevated from the fascia and removed.

3 The anterior incision was extended downward and backward across the neck and sternomastoid muscle.

4 The skin was elevated along the prefascial level.

5 The flap was rotated upward and forward

6. Anchorage was obtained with subcutaneous plain catgut 0 and suture with Dermalon 0000 (see Fig. 188 *b* p. 278)

CONGENITAL DEFECTS

Congenital asymmetries of the bony framework of the face and skull occur with moderate frequency These may be quite independent of differences in development in the two halves of the trunk and extremities, but they are frequently associated.

The facial cosmetic condition results, ordinarily from differences in contour and size of a bone or bones Striking imbalance occurs in the skull from failure of development of the diploe and one of the bony tables. This condition may be accompanied by unilateral bony bosses, or these may occur independently

Such asymmetries are frequently associated with palate and facial clefts and pathology of the soft tissue such as hemangioma, and less frequently with pigmented nevi, hemidystrophy and so forth.

*The average ordinary asymmetry does not warrant surgical correc*tion. Some of the moderate feature imbalances and all the extreme cases result in psychic disturbances which demand the best efforts of the surgeon. All admit of striking improvement which changes the appearance and outlook of the patient and many admit of perfect correction.

A more common asymmetry in the author's experience results from arrested bone development following some form of radiation treatment of hemangiomas pigmented nevi and so on, in infancy and during the following eight or ten years of facial bone development.

The dystrophies may or may not be associated with bone imbalances. They have occurred independently except in one instance in the author's experience.

Asymmetry of the Two Sides of the Frontal Skull and Face: *Case I* The difference in size and contour of the two sides of the forehead and face is strikingly apparent (Fig 225) This includes the frontal, orbital nasal maxillary and mandibular bones There are no inequalities elsewhere between the halves of the trunk and extremities.

There is no acceptable reason for correcting this type of cosmetic imbalance except in the simple reconstruction of the nasal bones

Asymmetry of the Frontal Bones, Orbital Walls, Facial Bones and Nose: *Case II* This results from an oxycephalus, which is discussed else-

where (Figs. 291, 477 pp 438, 706) The nose presents an excessive prominence of the nasal bones and a deviation to the left (Fig 226)

There is no cosmetic improvement indicated here other than correction of the nasal condition, both internally and externally



Fig. 225 Case I asymmetry of the two sides of the frontal skull and face nasal asymmetry (See p 332 for detailed discussion.)



Fig. 226 Case II asymmetry of the frontal bones, orbital walls, facial bones and nose, resulting from an oxycephalus. (See p 332)

Congenital Bone Asymmetry and Right Temporal and Facial Dystrophy

Case III. Note the median groove which appears in the frontal suture line from the glabella to the parietal articulations. The groove is 3/16 inch (4.5 mm.) deep and 1¾ inches (4.3 cm.) long. It is due either to a lack of development of the diploe and outer table or to trophic osteoclysis of these structures. The latter is highly im-

probable despite trophic absorptions elsewhere. Also the same, beginning above the supra-orbital notch and running outward and upward along the eyebrow to the temporal hair line. A large boss is included between these two grooves (Fig. 227 *b*)



Fig. 227 Case III congenital bone asymmetry and right temporal and facial *dystrophy correction with dermal implants. a* and *b* The *original* condition, *c* the condition after the organization of the first implant *d* that following the organization of the second implant. A third procedure produced a desirable cosmetic result. (See p. 333 for detailed description and procedure.)

There is a marked difference in the contour of the two *maxillae* and the *halves* of the mandible (Fig. 227 *a*) The left mental portion is ¾ inch (1 cm.) lower than the right (Fig. 227 *c*) There is a marked contrast in the two sides of the nose.

There is a marked right sided dystrophy The patient s mother first noted this condition along the mandible when the child was seven years old. The resultant, progressive psychic disturbance of the patient demanded surgical alteration of these disabilities

Foreign substances have less place, if possible in this cosmetic reconstruction than elsewhere in the body The psychic changes resulting from marked improve ment cannot be permanent under such circumstances. The choice of autogenous material to simulate normal structure and appearance is limited. The author has had partial success with fascia lata folded to include its attached fat and used as an implanted pad. The fat has suffered partial absorption. The procedure does not admit of repetition. The best results are produced by double layers of dermal im plants at proper intervals to permit the fibrous tissue organization of the implant, the total of consequent shrinkage and judgment of the required additions. These may be repeated to obtain the desired result.

Procedure STAGE 1

1 An incision was made in the temporal hair and along the anterior attachment of the ear (see Fig. 227 p. 334)

2. The skin along the mandible was elevated to its mental portion and carried beyond the borders of the concavity resulting from the trophic disturbance.

3 The length and width of a contracted, full thickness, double layer of skin to fill the dissected area was determined.

4 The epithelial layers from abdominal skin of this area were removed with a skin graft knife or dermatome. The required area of skin was excised, and the epidermal surface of this skin was thoroughly scraped with the graft knife.

5 The two layers of skin were cut to the desired size. The dermal surface of one layer was placed on the epithelial surface of the other and the edges were fixed with occasional sutures of 00000 plain catgut.

6. Strong sutures (dermal) were passed with a proper needle at each end (see p. 135) through the distal corners of the implant. The guide tube was inserted and passed from one corner through the dissected skin near the angle of the mouth and the others through the skin at the border of the mandible immediately below

7 The guide tube was removed and the implant drawn into place The draw sutures were tied lightly over a pad or rubber tube to retain the implant in place. The proximal end was fixed to the surrounding tissue with 00000 catgut.

8 The incision was closed with fine dermal suture. A dressing with moderate pressure was applied to control edema and so forth.

The traction sutures are removed in two or three days.

9 A horizontal incision was made in the hairy scalp across the sagittal line above the midfrontal groove. The scalp was elevated from the pericranium down to the glabellar area.

A single layer of dermal implant was prepared and managed as above.

STAGE 2. An interval of eight months elapsed. A moderate residual depression in the cheek remained, also the untouched area lateral to the malar

1 The original incision was opened, and abdominal skin prepared as above. The corium was incised for a single implant to include the attached connective tissue and fat down to the fascia. Implantation and dressing were as before.

2. An incision was made along the inferior hair line of the right eyebrow The skin was elevated over the depression lateral to the malar A single layer of corium was implanted.

The result of these two stages is seen in Figure 227 *d*

Acquired Asymmetry

Case I Asymmetry of the Upper and Lower Halves of the Body

The involvement of the trunk, upper extremities, neck, face, and so on is appar ently an acquired rather than a congenital disability It is a lipodystrophy following surgery There is a complete loss of fat and some subcutaneous connective tissue

in the upper half of the body and a perfectly normal development of the buttocks, thighs, legs, and so forth in the lower half.

The patient's family history was entirely negative, as was her own personal history until the age of twenty-six. At this time her weight was 135 pounds. She had an appendectomy oopherectomy and salpingectomy Her weight shortly after surgery was 105 pounds. The loss of weight and fat from her waist upward was rapid over a period of a few months. During this time she suffered tonic muscular spasms lasting five to ten minutes. Her physical examination, including an exhaustive neurological

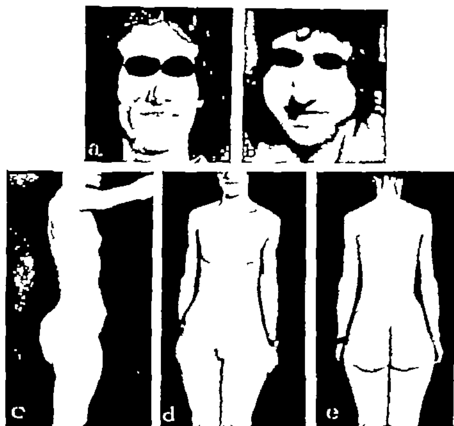


Fig. 228. Case I asymmetry of the upper and lower halves of the body facial correction with fat fascial graft from the right thigh implanted for organization under the abdominal skin (*A* in *c*)

a, Facial appearance before correction *b* appearance several weeks after over correction with a fat fascial pad *c* *d* and *e* marked dystrophy in the upper half of the trunk. (*See p. 335 for detailed discussion of the condition and the procedure for its correction.*)

examination, as well as her laboratory findings, was negative. Her complaint at the time of arrival here was dystrophy of both cheeks. She was satisfied with the condition of her nose, mouth, chin, eyes, forehead, and so on.

Procedure. STAGE 1

1 An incision 12 inches long was made through the skin to the fascia on the lateral surface of the right thigh.

2. The bordering skin and subcutaneous tissue were elevated.

3 A strip of fascia lata 3 inches wide and the length of this incision, retaining its attached fat, was excised.

4 This flap was folded to include the fat and sutured with fine catgut about its borders.

5 The skin incision was closed.

6 The skin of the abdomen below the umbilicus was incised and elevated. This fat pad was planted between the skin and the fascia.

This implant was allowed to remain in this location for four months in order to determine either a neurological or chemical condition which would absorb the fat in the pad in a manner like that which had destroyed the local fat

An interval of four months supervened.

STAGE 2.

1 The fat fascial pad was removed from the abdomen and a section taken for biopsy

2. An incision was made along the pre-auricular skin line, and the skin of the cheeks was elevated to the commissure of the mouth and the lower level of the mandible.

3 The fat pads were trimmed to the desired width and length and their edges sutured with plain catgut. The thickness of these pads was left in excess of their cosmetic requirements.

4 They were drawn into position with traction sutures on double needles (see Dermal Graft, p 135) The skin incisions were approximated with 0000 Dermalon. A pressure dressing was applied.

A microscopic report on the biopsy section showed marked atrophy of the fat, fibrosis in some areas and attempted organization and inflammatory reaction The amount of this atrophy did not reduce the thickness of these fat pads sufficiently to prevent their introduction of a size to overcorrect the cheek disability

Pigmented Moles

Pigmented nevi of various types are common congenital facial dis abilities. They occur less frequently on the trunk and extremities. Those on exposed parts, such as arms and hands demand the same manage ment as the facial lesions The manner of this management depends upon the histology of the lesion.

Case I. A Brown-Black Infra-orbital Nevus in a Child Aged Two Months. The lesion was 1¾ inches (4.5 cm.) long and 1¼ inches (3 0 cm.) wide. It involved the lid to ¼ inch (0 6 cm.) from its margin.

The benign character of the mole permitted multiple excision (see p. 228) and the use of the lid and lateral bordering skin to obtain a normal covering. The technical procedure is discussed in detail on pages 343–378

The condition presented was accomplished in four stages with *intervals* of five to seven months The child had an accident with infra-orbital abrasion ten days before this final picture The scar may be further improved at a later date.

Case II Melanotic Nevus of the Cheek and Margins of the Lips. The pathologic nature of this lesion must determine the surgical plan for its removal and recon struction of the resultant area. A multiple excision could not be considered if microscopic examination reveals *malignant* activity

The surgeon would be *limited* to wide excision, careful handling and a graft on the area with a plan to remove this, after a proper lapse of time, by multiple excision. A better choice, the one planned in this case, is the interpolation of a cheek neck flap for immediate repair (see Fig. 246, p 366)

The biopsy section showed marked pigmentation, confined to the epithelial layers, and no invasion of the corium.

Multiple excision in three stages at intervals of six months provided the result pictured in Figure 230 See pages 343–378 for technical discussion.

Cases III, IV and V are not only illustrative of variations in the type size and location of these disabilities, but also of the technical problems involved in their satisfactory removal Each correction is

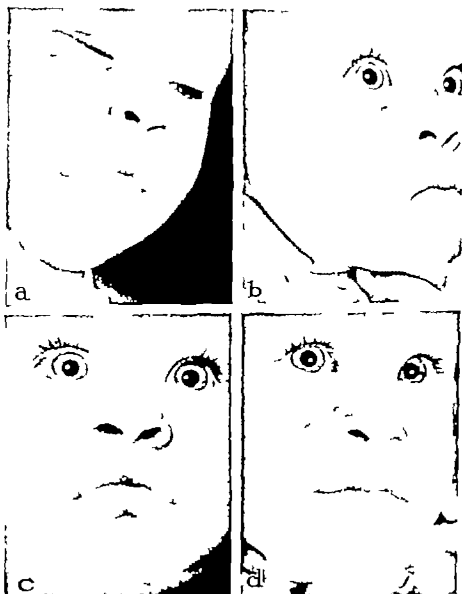


Fig. 229 Case I benign infra-orbital melanoma involving the eyelid multiple excision. (See p. 337 for details and procedure)

based upon a procedure fully described and illustrated under the discussion of Multiple Excision (see pp 343–378)

The lesion in Case III may be completely corrected in one stage by the procedure in Figure 244 (p 363) but this will leave a border scar on the cheek. It may also be accomplished in two stages with a "myrtle leaf" *incision within the borders of the lesion* The *superior* pointed end

of this incision should terminate at the anterior-superior border of the lesion The final line scar will be above the margin of the mandible, but may subsequently be brought below the mandible if this is essential, by multiple excision

In Case IV (Fig. 231 p 340) the pre auricular incision is made into the temporal hair The mesial incision is made down the nasofacial groove and around the mesial lip border of the lesion The lid incision is made just below the lid margin and slightly beyond the canthus A horizontal line of anchorage from the pre-auricular connective tissue to the nasal fascia prevents traction that can produce ectropion.







Fig. 230 Case II benign melanoma of the lips and cheek multiple excision. (See pp 343–378 for details and procedure.)

Several problems and questions for judgment are presented in Case V

The facial cervical and lip pigmentation demand removal. The involvement of the ear is neither a social nor mental handicap in this instance The buccal and gingival pigmentation is not disturbed under any circumstances.

The general management of the facial and cervical lesions is well illustrated and discussed in connection with Figure 247 (p 369) The vermilion of the lips may be restored by advancing the vermilion from the right side with a continued flap from the buccal mucosa of the same side

Angiomas

Angiomas are discussed in detail in Chapter IV (p 234) and Chapter X.

The vascular types of angiomas may occur anywhere on the body but 56 per cent of them actually occur in the head and neck. They present a variety of problems—cosmetic functional and vital. The responsibility



Case III



Case IV





Case V

Fig. 231 Cases III, IV and V are illustrative not only of variations in type size and location of these disabilities, but also of the technical problems involved in their satisfactory removal. (See pp. 343–378.)

of the plastic surgeon concerns each of these with the essential collaboration of indicated surgeons and the internist.

The surgical management which is the procedure of choice after infancy and the early developmental years of surface and combined deep lesions, is discussed *in the following pages.*

MULTIPLE EXCISION

It is suggested that the reader review carefully the discussion of Z plastic and this subject on page 221 Certain objections to the author's procedure and the reasons for these, as well as the planning and technic to avoid them are indicated

It is obvious that no fixed type of incision can be proposed for all cases, but the essential factors which permit the surgeon properly to meet his responsibility to the patient are the same in the variety and locations of the lesions presented It is the author's purpose to describe in detail the several applications of these principles which permit the surgeon to produce a result far superior to anything that can be accomplished with grafts, flaps and subsequent additions as commonly practiced today

Incisions. These should be planned (1) to avoid scar whenever possible, in the central part of the cheek and forehead (see Fig. 160 p 231, and Fig. 161, p 233), (2) to place a larger part of it along some of the grooves resulting from the muscle traction on the fibrous mesh in the skin—Langer's lines and folds, (3) to produce the finest, least noticeable scar away from the center of the cheek and forehead, by making incisions in and around the ear in the nasofacial groove, around the angle of the mouth, beneath the mandible, along or in the frontal and temporal hair lines, and along the infra-orbital margin or just beneath the palpebral lash margins

Preparation of the Flap for Advancement. The extent of such preparation depends, of course, upon the area of advanced flap required and the location of its availability This may involve the face skin only, but frequently requires the skin from the neck on both sides of the sternomastoid muscle and in the submental area down to the hyoid bone level.

The skin is separated in the subcutaneous fat plane above the superficial fascia by either sharp or blunt dissection This is a perfectly safe procedure as far as motor nerves and blood supply of the skin are concerned, if there is proper handling of the flap The only exception is the area of emergence through the fascia of the seventh nerve about the angle of the mouth. The separated areas are easily accessible through the incisions to be discussed.

Direction of Advancement of the Flap: Its Anchorage and Purpose; *Effect of Traction, Avoidance of Distortions.* The direction of traction depends upon the area to be replaced and the type and amount of normal skin required to accomplish this This may vary from direct vertical traction from below the mandible toward the zygoma or similar traction combined with a crescentic line of pull from behind and below the ear on both sides of the sternomastoid muscle Such a flap should not be anchored in the infra-orbital area. Its line of pull is forward upward and inward in such an instance It will invariably produce an ectropion and distortions of the ala and angle of the mouth

A flap with such traction will provide the maximum required amount of skin to be moved into the entire face area.

section through the connective tissue-fat plane above the fascia. Carry this dissection down the neck and posterior to the sternomastoid muscle to the level of the hyoid bone *Handle* the flap *with sharp hooks and not with tissue forceps* (see Fig 236, *d e* p 350)

4 Make traction vertically upward and mesially as indicated by the arrows Bring the point *I* to the point *A*

Mark the edge of the overlapping flap on the scar tissue

5 Dissect the scar tissue upward from the incision line to a line beyond that just marked by the border of the skin flap This should be just superior to the zygoma.

6 *Insert heavy Dermalon (00) traction sutures slightly above the* zygomatic line in the scar Pass the suture through the scar, then through the edge of the skin flap and then return it through the scar—a mattress traction suture. Strong traction and tying of these sutures (*A* in Fig 236 *a*) draw the skin flap to the proper line of excision of the condition with certainty of proper easy approximation

7 Excise the scar tissue

Pass a heavy plain catgut (0) suture through the strong connective tissue attaching the ear above the tragus and through the derma of the flap Project a horizontal line from this point across the lower orbital rim to the nasal fascia and pass a mattress traction suture through the skin and fascia at this point to the skin edge of the flap Anchor this point in the flap to the nasal fascia with catgut, after excision of the scar tissue Place catgut sutures 1 cm below each of the former ones.

Place catgut sutures similarly along the zygomatic fascia and through the connective tissue below the ear canal and the derma of the advanced skin flap

8 *Reconstruct the ear lobe with the triangular tab of skin above B*

The lobe should hang freely over the approximation line of the flap

9 Suture the approximating edges with 0000 Dermalon.

10 Apply a strip (2 inches, 5 cm) of 30 mesh gauze to the skin over the mandible with collodion (U.S.P) stretch it vertically, and apply to the temporal scalp This relaxation should be maintained for two weeks.

11 Dress with fluffed gauze and a Gauzetex bandage to apply moderate pressure for control of edema, and so forth

This skin flap properly managed will cover the entire cheek and the hairless temporal area of the scalp

Case II (Fig 234) *To replace the skin covering of the entire half face and temporal region with the skin along the mandible and the neck.*

The *technical procedure is identical with that in* Case I. Four stages are presented here The interval between stages varied considerably as the result of the patient s desire rather than because of any surgical necessity

These stages are presented to demonstrate the fact that the entire face may be covered with normal skin in this manner

Figure 234 *b* pictures the result of the initial stage. Vertical traction

only was utilized in Stage 2. Combined lines of traction permit the infra orbital advancement in Stages 3 and 4 as well as the type of anchorage described in Case I.

Problem II: *Case III* (Fig. 235, p 349) *To replace the pathologic skin of the frontal-temporal scalp half of the cheek half of the nose a third of the upper lip and both eyelids with normal skin*

This cosmetic disability results from years of treatment of a capillary hemangioma with radiation both x ray and radium, surface freezing and



Fig. 234 *Problem I (continued)* Case II *a*, burn of the face and forehead at the age of 6. The patient reported for continuation of the plan at long intervals. *b*, Appearance at the age of 12 *c d and e* the progress of the plan at the age of 21 (See p. 346 for details.)

so forth. It now consists of the usual residual spots or areas of heman gioma and many similar areas of skin atrophy and so on. It is apparent that both the patient and the lesion would have been more kindly treated by surgery in the beginning.

The case is presented to discuss the management of *the scalp with a sliding flap* and to point out the method of *recovering the nose* except ing the alae with normal skin from its opposite side and the adjacent cheek *by use* of the *same type of flap* Several other examples of this will be noted in other figures.

PROCEDURE Stage 1

1 Make the incision *ABC* from the top of the brow along the edge of normal frontal scalp to the point *B* 1.5 cm within the frontal hair

00000 Dermalon Incise its center along the lid margins, and suture these incised edges to the lid margins with 00000 Dermalon



Fig. 236 Diagrammatic presentation of the detailed steps of the procedure illustrated in Figure 235

Instill boric ointment and *apply a moderate pressure dressing.* Maintain this dressing for twelve days if the patient s condition permits.

This graft with lid adhesions is presented in Figure 235 *g* (p 349) These lid adhesions should be retained for three months or longer to allow adequate time for scar organization and prevention of any elastic pull of the cheek covering which may produce ectropion

Stage 6 Excision of lid adhesions, remaining pathology, and corrections of scars (Fig. 235 *g* p 349)

Problem III: *Case IV* (Fig 237, p 352) *To exchange normal bordering skin for the capillary hemangioma involving two thirds of cheek the entire lower lid half of the upper lid half of the nasal skin covering and half of the upper lip* The incision is planned to provide anchorage in the temporal scalp zygomatic fascia and the nasal fascia on a level with the lower orbital rim. The peri auricular incision and movement of the postauricular cervical skin are not essential here Note in Figure 237, *e* the lateral ectropion of the lower lid which results from the downward posterior elastic traction in spite of the anchor sutures, and so forth. This is of course, easily corrected in the following stage

The principal purpose of this discussion is a plan of covering the half lip without traction or distortion The detail of the procedure varies with the individual case and is largely influenced by the amount of submental skin brought up after extending the incision around the commissure of the lips and for 1 cm or more along the mucocutaneous line of the lower lip This also permits new skin covering on the lower lip

It is desired to *emphasize further* the method of *replacing the involved nasal skin* The author knows no desirable method of recovering the ala per se except with a full thickness graft of skin from the mesial surface of the ear The skin brought up from the lower face and neck is not so desirable

PROCEDURE Stage 1

1 Make an incision along the superior edge of the involved skin from the temporal hair line to a point 1 cm. external to the canthus and along the inferior orbital rim to the nasofacial groove Continue down this groove to the inferior border of the lesion at the lip commissure

2. Elevate and prepare the flap as described

3 Free the nasal skin over the anterior line by blunt dissection.

4 Make traction on the flap upward and *mesially* over the angle and horizontal ramus of the the mandible

5 Place mattress traction sutures to draw the nasal skin to the incision line

6 Excise the overlapping involved skin

7 Place catgut and Dermalon anchor sutures, and close the approximating edges with 0000 Dermalon sutures (Fig. 237 *b c*)

8 Dress

Stage 2.

1 Repeat the procedure above.

2. Make an incision along the mucocutaneous line to the border of the philtrum

3 Elevate the involved skin.

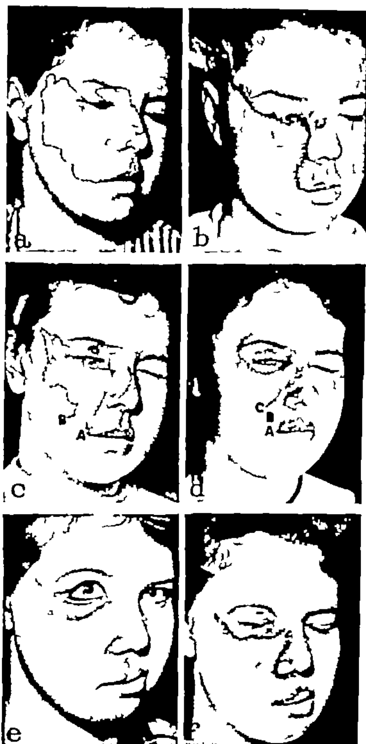


Fig. 237 Problem III Case IV management of the flap to cover half of the lip and the nasal skin covering; capillary hemangioma. (See p 351 for details and a technical discussion of the procedure.)

4 Measure and mark on the normal skin of the flap the distance from the commissure to the philtrum (Fig. 237, *c*)

5 Anchor the point *B* just marked to the fascia below the ala (Fig. 237 *d*)

6 Excise the overlapping lip skin.

7 Make an incision along the groove at the top of the ala.

8 Elevate the nasal skin beyond the anterior ridge, over the entire left lateral wall and bordering cheek.

9 Place mattress traction sutures

10 Excise overlapping skin and suture as above (see Fig. 237, *d*)

Stages 3 and 4

1 Proceed as in Stage 2 (The result of Stage 3 is seen in Figure 237, *e* and that of Stage 4 in Figure 237 *f*)

2 The length of the covering flap *AB* for the lip has already been established Mark the length of the philtrum *BC* (Fig. 237 *d*) on the flap

3 Make a small incision—about 1 cm—downward and slightly outward in the normal skin at *C* This incision is lengthened later as required.

4 Incise the mucocutaneous scar Incise around the attachment of the ala and floor of the nostril to the philtrum

5 Elevate the lip skin to the philtrum.

6 Make traction on the flap to bring the point *C* to the top of the philtrum and the point *B* to its mucocutaneous base

7 Incise and elevate again the skin of the nose as in Stage 2

8 Proceed to the conclusion of Stage 2

The procedure in Stage 4 consists in removal of the remnant in the philtrum, readjustment of the alar skin attachment, and removal of the remaining involved skin below the canthus and along the lid scar This permits resuture of the lid skin to a well-anchored (scar) infra orbital skin (Fig 237, *f*)

The eyelids are operated in a final concluding stage to be discussed later

Problem IV *Case V* (Fig. 238 p 354) *To replace pathologic skin covering of part or all of an eyelid with normal lid skin or a near approach to it—i.e skin from the mesial surface of the ear* Small abnormalities in the lid skin may be easily excised and the defect closed by sliding the adjacent skin between parallel incisions below the lower brow line and 2 mm above the lash line (Fig. 238, *a*) Larger areas, up to approximately one half of the lid may be corrected in the same manner by multiple excision

More extensive involvements are totally removed and replaced with grafted full thickness skin from another lid or the ear (see Fig. 246, p 366 and Blepharoplasty p 381)

Rotated flaps based external to the outer canthus and double pedicled flaps based beyond each canthus are frequently useful in transferring skin from one to the other lid.



Fig. 237 Problem III, Case IV management of the flap to cover half of the lip and the nasal skin covering; capillary hemangioma. (See p. 351 for details and a technical discussion of the procedure.)

4 Measure and mark on the normal skin of the flap the distance from the commissure to the philtrum (Fig. 237, c)

5 Anchor the point B just marked to the fascia below the ala (Fig. 237 d)

6 Excise the overlapping lip skin

7 Make an incision along the groove at the top of the ala.

8 Elevate the nasal skin beyond the anterior ridge, over the entire left lateral wall and bordering cheek

9 Place mattress traction sutures

10 Excise overlapping skin and suture as above (see Fig. 237 d)

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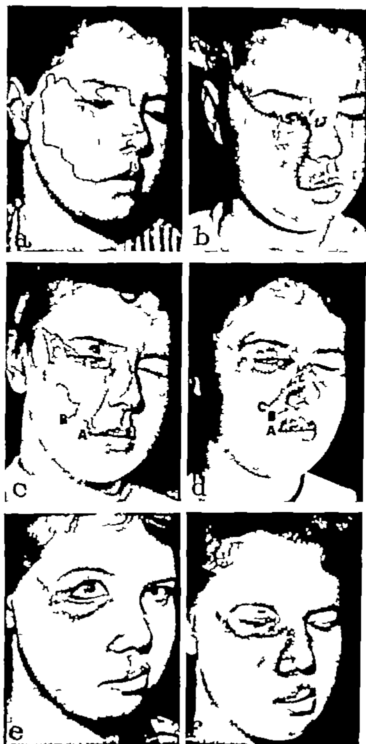


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7 Make an incision along the groove at the top of the ala

8 Elevate the nasal skin beyond the anterior ridge, over the entire left lateral wall and bordering cheek.

9 Place mattress traction sutures.

10 Excise overlapping skin and suture as above (see Fig. 237, *d*)

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7 Incise and elevate again the skin of the nose as in Stage 2.

8 Proceed to the conclusion of Stage 2.

The procedure in Stage 4 consists in removal of the remnant in the philtrum, readjustment of the alar skin attachment, and removal of the remaining involved skin below the canthus and along the lid scar This permits resuture of the lid skin to a well-anchored (scar) infra orbital skin (Fig. 237 *f*)

The eyelids are operated in a final concluding stage to be discussed later

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PROCEDURE This is evident in the drawings of Figure 238 and does not warrant discussion The grafting procedure is fully discussed on page 393 (Fig. 262)

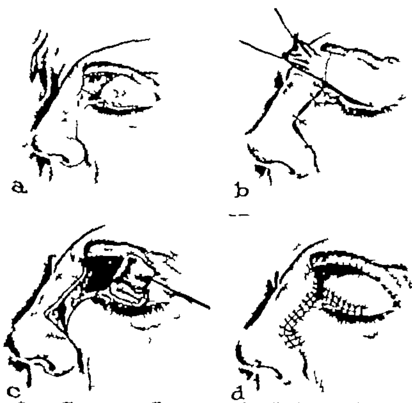


Fig. 238 Problem IV Case V to replace pathologic skin covering of part or all of an eyelid with normal lid skin or a near approach to it (see p 353) capillary *hemangioma of the mesial half of the upper lid, lower lid, infra-orbital area, nose and so on.*

Problem V: *Cases VI VII VIII IX* (Figs 239–243 pp 355 357 358, 362) *To transfer the normal skin along the horizontal ramus of the mandible in the submaxillary area and on the neck below to the entire face up to the zygoma to utilize this skin in the infra-orbital area without distortion*

Case VI This patient had a capillary hemangioma which was treated with carbon dioxide snow and much x radiation in early childhood and later This arrested the facial bone development and produced a marked *asymmetry as well as a sarcoma over the infra* orbital foramen The residual lesion is studded with areas of skin atrophy

It is apparent that maximum traction and proper periods of time for recovery of elasticity and tension would never permit the use of this skin directly in the infra-orbital area i.e with practically vertical traction without subsequent marked ectropion Further the entire lower

lid was concerned Horizontal anchorage in the usual manner is im possible

The author wishes to point out *one use of Z flaps which is quite different from the orthodox use to release scar contracture* Other uses will be discussed subsequently

PROCEDURE Stage 1 Remove the sarcoma.



Fig. 239 Problem V Case VI purpose and various uses of Z flaps in multiple excision *a*, Treated pigmented nevus with areas of skin atrophy infra-orbital sarcoma following radiation arrested development, facial asymmetry *b* Result of multiple excision new skin line passes from the external canthus to the angle of the mouth Z plastic to exchange infra-orbital pigmentation for normal skin in preparation for multiple excision without ectropion *c* Later stage of multiple excision. *d* Result of multiple excision and Z plastic. *e* and *f* Completed procedure. (See p. 354)

Stage 2.

1 Make a pre auricular incision *ABC* beginning in the temporal hairy scalp Continue this incision along the normal skin border to the mesial termination of the defect (*ADE* Fig. 233, *a* p 345)

2. Elevate the skin to a line 1 inch (2.5 cm) above the clavicle

3 Make traction vertically and slightly posteriorly Determine the extent of undermining the lesion superior to the incision line pass traction sutures, excise the involved skin and suture as described.

PROCEDURE This is evident in the drawings of Figure 238 and does not warrant discussion The grafting procedure is fully discussed on page 393 (Fig. 262)

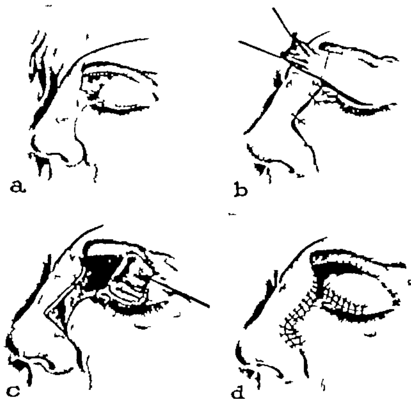


Fig. 238 Problem IV Case V to replace pathologic skin covering of part or all of an eyelid with normal lid skin or a near approach to it (see p. 353) capillary hemangioma of the mesial half of the upper lid, lower lid, infra-orbital area, nose and so on.

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Stage 2

1 Make a pre-auricular incision *ABC* beginning in the temporal hairy scalp Continue this incision along the normal skin border to the mesial termination of the defect (*ADE* Fig. 233 *a* p 345)

2 Elevate the skin to a line 1 inch (2 5 cm) above the clavicle.

3 Make traction vertically and slightly posteriorly Determine the extent of undermining the lesion superior to the incision line pass traction sutures, excise the involved skin and suture as described

4 Elevate the involved skin below the line *DBC* Proceed as de scribed. The purpose is to remove as much of the neck lesion as possible at each stage of the procedure

Subsequent Stages Repeat Stage 1 until the point *D* has been brought to point *A* and much of the cheek lesion has been replaced (Fig. 239 *c*) The subsequent procedure moves the good skin border to its maximum attainable position somewhat more mesial than in Figure 239 *c*

Design a Z with its central member along the normal skin border its lower lateral arm in the normal skin and its upper lateral arm in the infra-orbital lesion The transference of these flaps places normal skin where it will be advanced mesially and superiorly until it covers the lid and is anchored in the nasal fascia at the desired point. The other flap will be excised as the normal skin below is advanced to the tip of the normal flap at its point of anchorage This is accomplished by extending the original incision around the angle of the mouth and elevating this skin from the submental area

Case VII (Fig. 240 p 357) *To replace the capillary hemangioma of the lids infra-orbital area and half of the upper lip without bringing hair bearing skin into the lid and infra-orbital area above the lip beard* The lateral extent of the lesion in the cheek prevents advancement of the bordering skin as previously described without introducing hair bearing skin in the infra-orbital area in proximity to the lid There is a narrow area $^3/_4$ inch (1.8 cm) of hairless skin between the lesion and the beard

There is a choice between a rotated, interpolated flap from the temporal region and Z flaps to eliminate about the lateral half of the lesion, and bring the hairless strip of skin into the infra-orbital area to replace the remaining lesion below the lid. The latter is the procedure of choice

PROCEDURE Stage 1

1 Make a Z incision so that the central member (*DB*) runs from the superior margin of the lesion along its border to its inferior lateral extent. The upper lateral arm (*DB'*) extends along the orbital margin and is continued to the inner canthus (*A*) The lower lateral arm ex tends to the hair line (*BC*)

2 Dissect the involved skin below this incision to the lateral wall of the nose and this and the normal skin below the mandible Continue above the incision in the temporal area

3 Rotate the flap *DBC* and make traction on the point *B* to draw it as far mesial as possible a point mesial to *B* Make traction on the edge of the skin in the line *CBE* with a mattress traction suture passed through *B C'E* (note the tied suture just mesial to *C'* in Fig 240 *a* p 357)

4 Excise the overlapping involved skin along the dotted line *E*

5 Bring the point *B* to *B'* and suture. Suture all approximating edges with 0000 Dermalon. The result is seen in Figure 240 *b* (p 357)



Fig. 240. Problem V Case VII to replace the capillary hemangioma of the lids, infra-orbital area and half of the upper lid without bringing hair-bearing skin into the lid and infra-orbital area above the lip beard. (See p. 356 for detail of the procedure.)

Stage 2

1 Incise the scar line *CBE* (Fig. 240 *b*)

2 Elevate the skin (lesion) mesial and the normal skin posterior to this incision in the standard manner

3 Proceed in the same manner The result is seen in Figure 240 *c*

Stage 3

1 Incise the scar line of Stage 2 and proceed in the standard manner The result is seen in Figure 240 *d e*

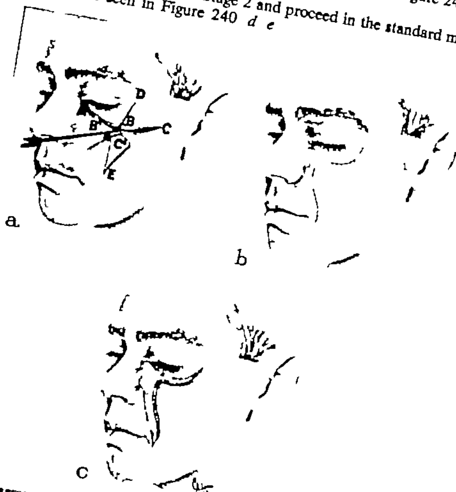


Fig. 241 Diagrammatic illustration of the Z plastic procedure discussed under Figure 240 (See p. 356 for the detail of the procedure.)

Stage 4 Replacement of the skin of the lower lid with a full thickness graft from the right upper lid (see Blepharoplasty p 381)

Stage 5

1 Incise the scar along the inner half of the orbital margin and continue the incision in the normal skin along the nasal facial groove to the termination of the former incision on the lower lip

2 Elevate the involved skin on the nose and the skin of the cheek in the standard manner

3 Make traction superiorly and mesially

4 Excise the remaining lesion Treat the elevated normal skin as described in Case IV (p 352) to provide the skin required to cover the upper lip

Stage 6

1 Open the inferior scar along the flap in the temporal area. Separate the flap Excise the excess tissue Suture.

2 Revise the remaining scar

3 Make parallel incisions along the palpebral margin of the upper lid and the inferior hair line of the brow Elevate the lid skin from the mesial end of the lid beyond the residual lesion Excise the involved skin Advance the remaining lid skin and suture

The result of the procedure is seen in Figure 240 *g*

Case VIII (Fig. 242 p 360) *To replace the hypertrophied scar of the left cheek neck ear lip and nose with normal skin to repair the scar (contraction) distortion of the left nose* The entire nasal skin covering is replaced with burn scar There is no available bordering skin for its replacement. The remaining choice is the entire mesial skin covering of both ears.

The use of a graft or flap for replacement of the left cheek surface would merely exchange cosmetic disabilities The bordering neck skin is an excellent match in both texture and color for the face skin The choice of a method of transferring it without excessive added scar is the use of Z flaps in the manner of the present discussion

PROCEDURE Stage 1

1 Excise the scarred skin of the entire nose from the glabella to the tip Dissect completely the scar elevating and everting the left nostril Suture the nostril lining in overcorrection of its normal level (Fig. 242, *a* p 360)

2 Remove the skin from the mesial surfaces of both ears. Split skin graft the defects.

3 Apply the ear skin to each half of the nose (see p 360)

4 Dress with a molded splint.

5 Replace the left eyebrow loss with a retro-aural scalp graft (see Fig. 191 p 281)

6 Apply a pressure dressing to remain unopened for ten to twelve days.

Stage 2.

1 Make a Z incision with its central member along the cervical scar Incise the superior lateral arm in the hypertrophied scar of the cheek and the inferior arm in the normal cervical skin

2. Elevate the flaps and bordering cheek and neck skin by blunt dissection

3 Transpose the flaps and utilize traction sutures to determine the maximum facial scar that can be excised without distortion Excise and suture (Fig. 242 *b* p 360)

4 Complete the scar excision about the inner canthus and in the infra-orbital area The facial scarred skin and that below the lobe of

the ear are now in a position where they can be removed by multiple excision as the normal skin flap is advanced and elevated

Stage 3

1 Incise the borders of the normal Z flap



Fig. 242. Problem V Case VIII to replace the hypertrophied scar of the left cheek, neck, ear lip and nose with normal skin, to repair the scar (contraction) of the left nose (See p. 359 for detail of the procedure.) *a*, The scar from a third degree burn, destruction of the nasal skin covering and the left ala hypertrophied scar and keloid. *b* The nose has been covered with full thickness skin from the mesial surface of the ears. Z plastic has placed normal skin in position for multiple excision of the hypertrophied scar on the cheek. *c* Further advancement of the Z flap and excision of the hypertrophied scar *d*, The finished procedure.

Make an incision along the anterior border of the scar involving the ear lobe Carry this incision to that along the Z flap below

Freely elevate the bordering skin and the neck skin at the base of the Z flap the scar flap and its bordering base

2 Reconstruct the ear lobe

Excise the scar surrounding the lobe

3 Advance the normal Z flap with traction sutures

Excise the scarred flap (Fig 242 *c*)

Stage 4 Complete the excision about the mouth and lip (see Fig. 242 *d*)

Case IX (Fig 243 p 362) *To replace with normal skin a port wine stain (naevus vinosus) involving the inner fourth of the upper lid the left side of the nose to the dorsum the lower lid the left half of the upper lip left face to within 1 inch (2.5 cm) of the ear attachment and half of the temporal area*

The management of this case was planned and it was operated initially fifteen years ago There was a lapse of ten years during which the patient was not seen. This period developed and clarified some of the simple basic principles which we are discussing. Some of these would indicate a simpler plan, permitting a more rapid accomplishment of the desired result.

The case is presented to demonstrate use of Z flaps in replacing pathology in the palpebral and infra-orbital area and in transferring this skin to an area where it may be excised without disability It is similar to the use of temporal skin in Case VII (p 356) It is desirable here to utilize the narrow strip (¾ inch, 2 cm) of normal skin in front of the ear

The case demonstrates also the use of a rotated, interpolated flap from the upper lid to replace the involved skin on the lower lid and the re-covering of a half of the upper lip with skin from the cheek flap.

PROCEDURE

Stages 1 and 2 Incision was made within the lateral border of the lesion from its superior edge in the temporal area to a point external to the lip commissure. The skin on either side of this incision was treated in the standard manner indicated. The result ten years later is seen in Figure 243 c.

Stage 3 The patient reappeared for further surgery after a ten year interval. The original scar was incised, the flaps were prepared, and the maximum of the lesion was excised in the standard manner The lateral traction of the normal skin toward and below the ear resulted in an ectropion of the lateral third of the lid which precluded further use of the previous procedure (Fig. 243 *d*) It was decided to use a Z flap which would ultimately replace the lid and infra-orbital lesion and permit permanent correction of the ectropion.

Stage 4

1 A Z was incised as located in Figure 243 *c* Its central arm was extended along the inferior border of the remaining temporal lesion, and the upper lateral arm followed the lid margin just below the lash follicles. The lower lateral arm was modified to curve outward and downward across the cheek so that traction on this flap elevated the cervical skin anterior to the sternomastoid muscle See the scar in Figure 243 *e*

2. The flaps were prepared and rotated in the standard manner Much of the pathologic superior flap was excised because of the advancement of the normal skin flap.

3 Suture and completion were done in the usual manner The ectropion persisted, of course

An interval of 3 weeks elapsed.

Stage 5

1 A flap ½ inch (0 7 cm.) by 1¾ inches (4.5 cm.) based external to the canthus on the upper lid, was incised.

2. The skin covering of the lower lid was excised.

3 The skin flap was rotated from the upper lid and sutured in place below

4 A surgical adhesion was created between the two lids at the junction of their middle and outer thirds (see Blepharoplasty p 381 for detail)

5 The cheek flap was prepared below the Z flap incision across the cheek and advanced. The maximum pathologic tissue along the lip and lateral nose was excised in the usual manner· likewise in the temporal area.

The result of this stage is seen in Figure 243 *f*



Fig. 243 Problem V Case IX naevus vinosum. The original lesion and some of the various stages of the procedure are presented. Contraction of the chin fold and the scar above the inner canthus concludes the procedure. (See p. 361 for technical procedure and details.)

The patient was again without service for four years. At this time the balance of the lesion on the face, nose and lip was replaced in the usual manner (see Fig. 237 p. 352)

The cheek scar is no longer acceptable. The result could have been readily accomplished by the procedure indicated in Figures 232 (p. 344) and 234 (p. 347)

Problem VI. Case *X* (Fig. 244) *To heal a third degree burn of eight weeks' duration and to replace the scarred area of one half of the cheek with normal hair-bearing skin and a minimum scar*

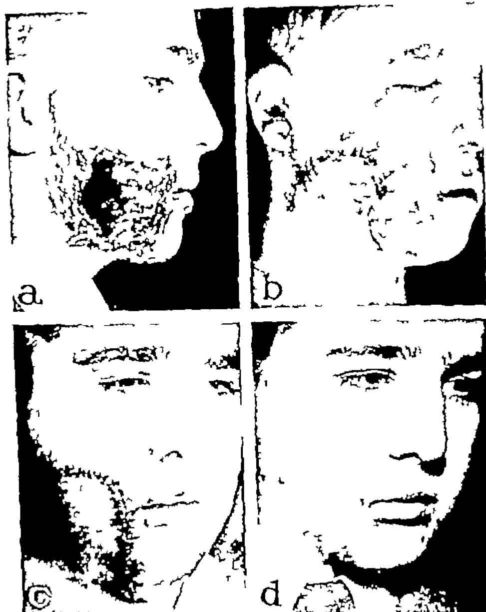


Fig. 244 Problem VI, Case X the use of rotated flaps, advanced or interpolated. *a*, Third degree burn of 8 weeks duration skin graft, ulceration of the posterior half of the area. Normal hair-bearing skin is available on the posterior border on the neck inferiorly and in the submental area. *b* The first stage of the procedure. *c* and *d* The final stage of the reconstruction. (See text for detail of the procedure.)

The patient came with a large, infected ulcer of the lower cheek in front of the masseter muscle and an unhealed area mesial to this which surrounded the commissure of the lips. The latter area presented numerous bits of skin graft, the result of both split and full thickness procedures. The cheek scar surrounding this area contained dirt (Fig. 244 *b*)

It was desirable to replace the covering of all these areas with hair-bearing normal skin Such skin was available on the posterior border in the neck below the involvement and in the submental area. It was further desirable, of course, to accomplish this with minimum visible scar *A rotated, advanced flap* was the choice (Fig. 244 *a, b*)

PROCEDURE Stage 1

1 A curved incision was made from the posterior border of the sternomastoid muscle upward, forward and downward along the border of the mandible to the healed scar (Fig. 245 *a*) and a second incision around and behind the ear lobe.

2 The base of the ulcer and the anterior scar was undermined as also the cervical flaps below and behind the incision, and the cheek flap superior to it.

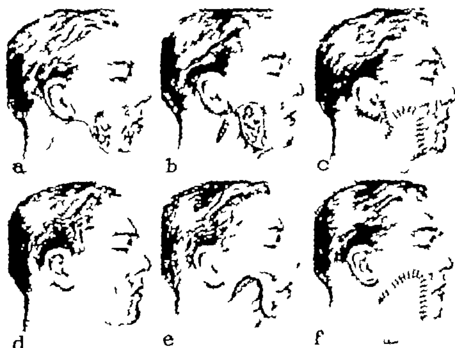


Fig. 245 Problem VI diagrammatic illustration of the various steps in the procedure. (See p. 363 for detailed description of the procedure)

3 The flap was rotated anteriorly Mattress traction sutures were placed and the skin flap drawn under the scar The pathologic skin was excised along its border (Fig. 245 *b*)

4 The scar in the cheek flap was excised along the upper border of the rotated skin flap (Fig. 245 *b*)

5 The neck flap was advanced from behind the sternomastoid muscle to close the defect.

6 Suture was done with 0000 Dermalon (Fig. 245 *c*)

The result of Stage 1 is seen in Figure 245 *b*

Stages 2 3 and 4 are repetitions of Stage 1 except that there is no necessity to utilize further the incision about the ear lobe and the posterior cervical flap. Stage 2 is demonstrated in Figure 245 *d e f* The results of Stages 3 and 4 are seen in Figure 244 *c d*

Problem VII: *Case XI* (Fig. 246 p 366) *To reconstruct one half of the lip and the left ala to restore the normal length of the palpebral fissure correct the ectropion of the lower lid recover the lower lid and*

o replace the atrophied skin and residual hemangioma of the face (infra orbital) and lateral wall of the nose with normal skin and minimum scar

The patient had a congenital hemangioma involving the lid infra-orbital skin, he lateral wall of the nose and one half of the upper lip

This was treated by x ray and radium in infancy and the following years. The reatment resulted in loss of vision in the left eye ectropion arrested bony development (asymmetry) marked atrophy of skin and muscle in the infra-orbital area and he lateral nose, destruction of part of the ala and slough of part of the lip with lense, residual scar in its upper lateral remaining border

PROCEDURE Stage 1 The lip was prepared for reconstruction

1 The dense scar about the lip defect was excised (see Fig. 246, *a* p 366)

2. The mucosa surrounding the incised skin edges was freed and advanced and sutured to the skin edge

The mucosa on the mesial margin was to be utilized to make the vermilion border of the new lip That in the lateral border would furnish much of the blood supply for a hinged (rotated) lining flap

An interval of six days elapsed.

Stage 2.

1 An external canthoplasty was performed to restore the normal length of the palpebral fissure.

2. A Z was outlined (incised) with its central member along the posterior border of the malar scar The upper lateral arm was incised along the infra-orbital margin and the lower lateral arm in the normal cheek skin below the zygoma (see Fig. 246, *a*)

An interval of sixteen days elapsed.

Stage 3 Correction of the Ectropion

1 The entire scarred lid covering was excised. Surgical adhesions were created between the lids at the junctions of the mesial and middle and the lateral and middle thirds (Fig. 246 *d* p 366)

2. The required skin was removed from the right upper lid The defect was sutured (see Blepharoplasty p 381)

3 A lining and covering flap for the lip reconstruction was outlined (incised) the width of this flap being adequate for use in multiple excision above the lip

An interval of four weeks elapsed.

Stage 4 Cheiloplasty Multiple Excision.

1 The lining (*A*) and covering (*B*) flaps were incised and elevated The flap *A* was elevated to about ¼ inch (0.5 cm.) from its mucosal attachment. Its blood supply depends upon this tissue.

2. The skin bordering the flap was elevated, advanced and sutured.

3 The mucosa was incised and separated from the superior border

4 The mucosa was incised along the skin of the mesial lip down to the vermilion. A parallel incision ⅜ inch (1 cm.) wide was made from the sulcus to about ½ inch (1.3 cm.) above the junction of the vermilion and mucosa. This flap was elevated

5 The lining flap from the cheek was rotated and sutured to the mucosal borders mesially and superiorly

6. The covering flap was rotated and sutured to the mesial skin borders of the defect.

7 The mucosal flap reflected from the lip to the edges of the lining and covering flap was sutured to furnish the vermilion border

The superior border of this flap is in excess of the lip requirement and is used in the multiple excision superior to the lip

8 The previously outlined 7 flaps were incised and elevated. The cheek skin was elevated to the ear attachment.

9 Mattress traction sutures were inserted and the Z skin flap and bordering cheek skin were advanced to its maximum point. The involved skin in the overlying rotated Z flap and that overlapped by the advanced cheek skin and the upper border of the rotated lip covering flap were excised.

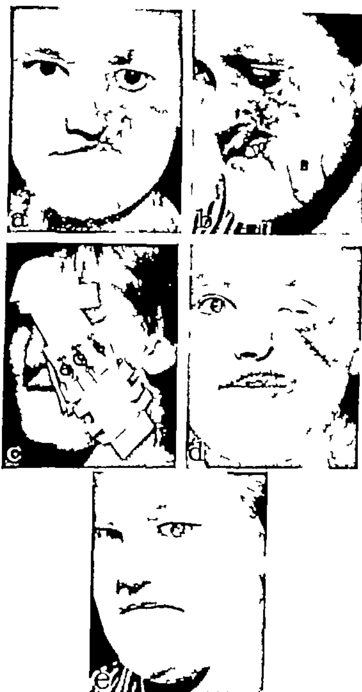


Fig. 246 Problem VI Case XL *a*, Ectropion, cataract, atrophy of the skin and underlying tissues, arrested bone development and partial destruction of the lip as the result of roentgen radiation of a pigmented nevus in early childhood. *b* Reconstruction of the ectropic eyelid with a full thickness graft from the upper lid surgical adhesion of the lids to prevent contraction during the period of organization outline of the flaps for reconstruction of the lips and face. *c* Elastic relaxation adhesive dressing maintained by dress hooks. *d* Completed construction of the lip surgical adhesion of the lid margins and advancement of normal skin into the atrophic area. *e* Appearance two months after the completion of the repair (See p. 364 for detail of the procedure.)

10 Suture and dressing were done in the standard manner Elastic traction was applied over the later dressings to relax the suture lines and hasten the skin relaxation, permitting further excision (Fig. 246 c p. 366)

An interval of four weeks elapsed.

Stage 5 Multiple Excision. The Z flap of normal skin was elevated and advanced again. The upper border of the rotated lip flap was utilized in the same manner to eliminate the remainder of the infra-orbital scar

An interval of six weeks elapsed.

Stage 6. Cheilomeloplasty The reconstructed vermilion border was readjusted. The angle of the mouth was lowered to the desired level (see p. 612 see also Fig. 246, d)

An interval of four weeks elapsed

Stage 7 Rhinoplasty The left nostril was everted and elevated ⅜ inch (1 cm.) by scar

An incision was made along the entire upper border of the ala. This flap and the scar elevating the ala were dissected. The flap was rolled downward to provide the rolled alar edge The resulting defect in the nasal wall was covered with skin from the mesial surface of the ear

The result of these procedures is seen in Figure 246 e

Problem VIII: *Case XII* (Fig 247 p 369) *To re-cover with normal bordering skin of desirable texture and color the entire lower half of both cheeks the chin and lip and the left neck from the trapezius muscle to the midline to eliminate the pathological condition and re construct the lower lip to correct the abnormal mental part of the mandible*

There was a capillary hemangioma involving more than half of the entire face and much of the neck. It began about ½ inch (1.5 cm.) above the ear canal on the right side and extended diagonally downward across the face to the upper lip at the commissure, around this to involve the entire lower lip and chin, and then upward and outward to the top of the left ear canal (Fig. 247 a, b c p 369)

The entire right cheek below the above line, the retro-aural area to the trapezius muscle and down its border to the level of the jugular fossa, across the neck and upward past the median line to the mandible, was the site of this lesion on the right side (Fig. 247 b)

The skin over the larynx, the submaxillary fossa and entire lower half of the left cheek to the line described above was also involved (Fig. 247 c)

The lower lip was ¾ inch to 1 inch (2 to 2.5 cm.) thick from its free border to the buccal sulcus. This resulted from cavernous hemangioma and a greatly hypertrophied orbicularis oris muscle.

The mental part of the mandible—the chin—was excessively long, producing a profile that exaggerated the lip condition.

PROCEDURE: The entire procedure was accomplished with block and infiltration anesthesia—procaine (0.5 per cent) and epinephrine (1 2000)

Stage 1

1 A flap on the left neck was outlined of desirable width and length to replace the involved skin on the cheek and one half of the chin. Rotation required that this flap be based upon and posterior to the sternomastoid muscle and the area 1 inch (2.5 cm.) below and anterior to the ear lobe. The required length reached the superior border of the clavicle. This was in reverse of the direction of the blood supply and required adequate "delay" before rotation. The flap was 2¾ inches (7 cm.) by 7½ inches (19 cm.)

The anterior border was incised from the angle of the mouth to the clavicle, and its inferior border along this line. The flap was separated by blunt dissection.

2. A transverse incision was made along the crease in the lower lip. All sides of the incision were dissected for vascular anomalies connected with the lip.

It was noted in this case that the segment of the external maxillary artery just

external to the lip commissure was dilated two and one-half to three times its normal. It appeared normal lateral and above this point.

A dissection of the lower lip revealed little cavernous tissue below the skin and mucous membrane. There was great hypertrophy of the orbicularis and triangular muscles.

3 The dilated vessels were ligated.

4 About three-fourths of hypertrophied orbicularis oris muscle was excised longitudinally from angle to angle.

5 Suture was effected.

An interval of four weeks elapsed.

Stage 2. Flap Delay

1 The posterior border of the planned flap was incised.

2 The inferior third of the flap was elevated.

3 Suture was made.

An interval of three weeks elapsed.

Stage 3 Flap Delay

1 The entire flap was elevated.

The circulation was satisfactory until the flap was rotated. Its return was poor It became congested and was resutured in its bed.

An interval of three weeks elapsed.

Stage 4 Rotation of Flap (Fig. 247 *e* p. 369)

1 The flap was elevated.

2 The bordering skin was elevated and approximated to the maximum with traction sutures.

3 A V type of excision was made in the center of the lip, and closed with silk sutures passed from the buccal surface.

4 The flap was rotated 90 degrees.

Its borders were marked on the cheek and chin, and this involved skin was undermined. Mattress traction sutures were passed to determine the line of excision, and closed with Dermalon 0000

5 The defect remaining in the neck skin was approximately 1¼ inches (3 cm.) wide. This area was split skin grafted. The ultimate contraction of this graft and further relaxation of the neck skin permitted its removal later

An interval of four weeks elapsed.

Stage 5 Multiple Excision.

1 The superior border of the rotated flap was incised, and the incision carried laterally and upward in the pre-auricular area.

2 The bordering skin was elevated The involved skin, about 2 inches (5 cm.) was excised in the standard manner

An interval of eight weeks elapsed

Stage 6. Outline of Right Neck Flap. The lower level of the involved neck skin was along a curved line from the top of the jugular fossa upward to the border of the trapezius muscle (see Fig. 247 *F* p. 369) The available useful skin extended from this line over the clavicle and up the posterolateral neck to the hair line. The superior lateral area was to be the base of the flap.

1 The outline of this flap was incised 3½ inches (9 cm.) by 6 inches (15 cm.) (Fig. 247 *f*)

2 The involved skin along the superior line of this incision was elevated and excised the maximum

3 Suture was made.

4 An incision was made ½ inch (1 cm.) above and parallel to the border of the right mandible. The involved skin of the cheek was elevated widely above this incision. Traction sutures were placed and excision accomplished, about 2 inches (5 cm.) in width (Fig. 247 *f* [scar line AB])

5 The superior scar along the flap in the left cheek was reopened. The involved skin above was elevated and excised.

An interval of eight weeks elapsed.

Stage 7 (1) Partial Resection of Mandible (2) Delay Flap of Right Neck.



Fig. 247 Problem VIII Case XII capillary and cavernous hemangioma, hypertrophy of the orbicularis oris muscle in the lower lip elongation of the chin. *a*, *b* and *c* The original condition *d* Stage 1 outline and delay of left neck flap excision of part of the hypertrophied lip muscle and ligation of the efferent and afferent dilated vessels. *e* Stage 5 rotated neck flap and grafted neck together with multiple excision of the left cheek. *f* Stage 6 the result of multiple excision in the neck and cheek. *g* The resected mental part of the mandible. *h* The result of a Z plastic exchanging the normal neck flap for the pigmented flap along the mandible *i* and *j* Further multiple excision. *k*, *l* and *m* The result of the procedure. (See p. 367 for detailed discussion of the procedure.)

1 The scar tissue was excised from the end of the rotated left flap on the chin and its surroundings. The excision was continued to the periosteum along the lower end of the mental part of the mandible.

2. The lower mental border between the mental foramina was excised and a piece 5.5 cm. long and 1.5 cm. wide was removed (Fig. 247 g)

3 The right neck flap was elevated and its lower border extended posteriorly about 4 inches (10 cm.)

4 The flap was returned to its bed and resutured.

An interval of eight weeks elapsed.

Stage 8 Rotation of Right Neck Flap.

1 The neck flap was elevated.

2. The scar *AB* was incised along the mandible and the incision continued along the border of the pigmented area below the ear until it joined the base of the neck flap

3 This pigmented flap was elevated, leaving its base in the median line of the neck.

4 The two flaps were transposed. The distal end of the upper flap was sutured to the lateral border of the chin. The pigmented skin was elevated above the mandible, excised the maximum, allowing approximation to the skin flap—about 3/4 inch (2 cm.)—and sutured (see Fig. 247 *h*) This permitted multiple excision of the pigmented skin in the neck.

An interval of twelve weeks elapsed.

Stage 9 Excision.

1 The scar along the superior edge of the flap was incised and the incision continued posteriorly into the redundant tissue resulting from rotation of the flap.

This good skin was used to further excise pigmented skin behind the ear and on the cheek (Fig. 247)

An interval of eight weeks elapsed.

Stage 10 Redundant Lip Mucosa.

1 A curved incision was made from angle to angle in the lip mucosa about 3/8 inch (1 cm.) above the sulcus.

2. This flap was dissected to the vermilion junction, the border readjusted, and excess mucosa excised. Suture was made.

An interval of twelve weeks elapsed.

Stage 11 Excision of Neck Lesion. The remaining pigmented tissue in the neck and median line now permitted considerable excision (see Fig. 247 *i*, *j*) The point *B'* can be brought to the point *B* and the point *A* well up to the scar line under the chin. The elevated skin on the left neck will eliminate the triangle of the lesion below *A*

1 The superior border of the lesion was incised from the left neck below the thyroid cartilage through the points *A* and *B* to the point *B'*

2. This entire pigmented flap was elevated freely beyond its inferior and posterior borders.

3 The skin flap above it was elevated freely

4 Traction sutures were passed to bring *B'* to *B* the distal point of the flap upward and laterally and the skin of the left neck well upward and laterally to the right.

5 The lesion was excised—about 12 cm. in length—and sutured (see Fig. 247)

An interval of twelve weeks elapsed.

Stage 12. Further excision was done about the lower border of the neck lesion, around the ears and around the right angle of the mouth.

Problem IX *Case XIII* (Fig 248 p 372) *Removal of the nevus and its replacement with normal bordering skin without sacrifice of the normal skin between the nose and the lesion below the malar to utilize this skin for the advancement of the required cheek skin and its advancement to the lower orbital border* The replacement of the lip nose

and lid lesions may then be accomplished by standard procedure The lesion in the hair line extending below the zygoma should be managed finally after completion of the above problem.

The nevus begins at the left of the midline of the glabella at about the level of the upper margin of the eyebrow extends down the mid dorsal line of the nose to the end of the nasal bones, deviates slightly to the left and extends to the top of the ala. It includes about one third of the skin of the upper lid, all the skin covering of the lower lid and below the orbital margin ¼ inch (0 5 cm) It covers the entire malar bone and extends down to a point ¾ inch (2 cm) above the angle of the mouth

The lesion on the lip has a vertical median and parabolic lateral border The lesion in and below the temporal hair extends downward forward and inward 2½ inches (6 5 cm) About three quarters of this is on hairless skin

PROCEDURE Stage 1

1 Incise the border of the normal skin above the lip along its junction with the nevus Make an incision along the lower orbital margin from the inner canthus to the border of the lesion lateral to the external canthus

2 Elevate the normal skin flap to the upper lip border Elevate the nevus and bordering cheek skin to the lower border of the mandible

3 Rotate the skin flap and make traction toward the inner canthus.

4 Elevate the nasal skin over the lateral wall and beyond the dorsum.

5 Pass traction sutures through the nasal skin and the edge of the elevated flap Excise the pigmented skin along the border of the normal skin flap and suture.

6 Pass traction sutures through the nevus on the edge of the cheek flap and the lateral edge of the elevated normal skin flap Excise the nevus along this border and suture (see Fig. 248 c p 372)

An interval of eleven days elapses

Stage 2 Blepharoplasty The author prefers this procedure as the final one Accessibility of the patient and other considerations make it preferable now

The entire skin covering of the lower lid is replaced with skin from the right upper lid (see Blepharoplasty p 381)

An interval of four months elapses

Stage 3 Excision

1 Incise the scar along the infra-orbital margin and both borders of the normal skin.

2 Elevate the nevus and adjacent skin in the temporal, cheek and cervical area below the mandible to the sternomastoid muscle. Elevate the normal skin flap and the nasal skin on the lateral wall. Excise the involved nasal skin, and suture This permits also a stage in the multiple excision of the lip condition.

3 Place mattress traction suture in the nevus and lateral edge of the flap to draw the cheek flap upward and inward.

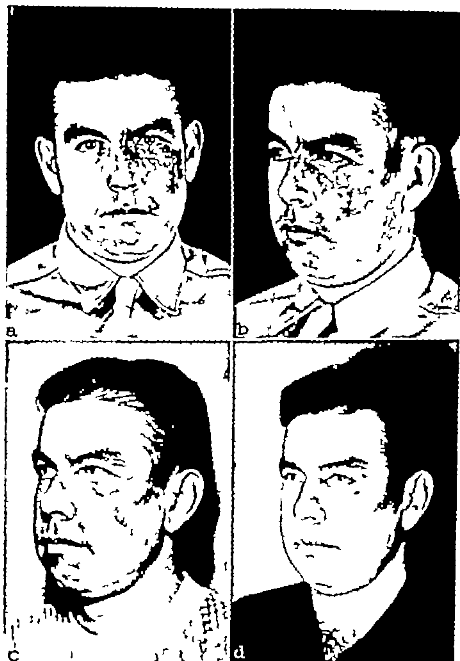


Fig. 248 Problem IX Case XIII special adaptation of cheek flaps, removal of a nevus and replacement with normal bordering skin without sacrifice of the normal skin between the nose and the lesion below the malar the utilization of this normal skin. *a* and *b* The original lesion. *c* The utilization of the normal skin about the lesion with bordering cheek skin as a flap for reconstruction. *d* The present result of the procedure. There are small areas of lesion to be excised or sclerosed (See p. 370 for detailed description and procedure)

4 Incise the lesion along the normal skin border

5 Suture

About three quarters of the malar lesion was removed in this instance A small wedge of the lesion was removed from the outer canthus (Fig. 248, c)

An interval of three months elapses.

Stage 4 Excision Excise the pigmented skin over the malar bone and the nasal skin in the manner discussed in Stage 3

An interval of seven months elapses

Stage 5 Blepharoplasty Scar Revision

1 Make parallel lid incisions along the brow line and above the lash line of the lid

2. Elevate the skin laterally well beyond the pigmented lesion

3 Make traction medially and excise the maximum permitting closure. About 75 per cent of the lesion was removed in this instance (see Fig. 238 p 354)

An interval of ten months elapses.

Stage 6 Blepharoplasty, Scar Revision Complete the excision of the upper lid lesion in the manner discussed in Stage 5 Revise the various scars as indicated (see Fig. 248 *d*)

Problem X *Case XIV* (Fig 249 p 374) *Excision of a capillary and cavernous hemangio-endothelioma with early malignant change (mitosis and so forth) involving one half of the lip the left cheek and the orbit inferior and mesial to the globe reconstruction of these areas with normal bordering skin* This problem consists of multiple considerations.

This child was presented at the age of six months after receiving three treatments with x ray and one with radium without apparent change except for marked surface atrophy and scarring. The time element was probably insufficient for the deep sclerotic changes which were anticipated. Surgical management was postponed for the following six months to observe any improvement. The cheek lesion was 2½ inches (6.5 cm.) by 1½ inches (4 cm.) in diameter and elevated about 1 inch (2¼ cm.) Note the dilated vessels with bulbous terminations in the skin above and lateral to the lip in Figure 249 *a, b c* (p. 374) This increase in size (telangiectasia) following tension on the skin has been a frequent observation in these cases. *It is seen in the sutured margin of the normal skin and not infrequently at a distance as an apparent result of the increased pressure in an extended or stretched capillary with congenitally defective walls The stretched capillary has a reduced lumen with consequent increased pressure a "bottle neck" that will not locally withstand a higher pressure The degree of the congenital condition varies from the site of the visible lesion in the capillaries of the apparently normal surrounding skin*

PROCEDURE Stage 1

1 A heavy continuous quilting suture was passed through the skin to the mucous membrane around the *tumor mass from the orbital margin* to the top of the lip and thence along the nasal side of the mass to the point of beginning. Strong traction was effected, and the ends were tied.

2. An incision was made in normal skin, beginning at the tumor margin on the lateral lower orbital rim, and continued around the border of the tumor to the dilated vessel above the mass in the lip.

3 The tissue around this tumor margin was incised between hemostats down to the fascia, with elevation and separation continued in this manner


a
b
c
d

It was found that this mass did not penetrate the fascia. The surgeon was relieved of the necessity of isolating the facial nerve the maxillary artery and the parotid duct.

This main tumor mass was excised.

4 The heavy suture was released. The bleeding points were ligated.

5 The bordering cheek skin was elevated freely The lateral half of the skin lesion was excised, and the cheek flap advanced and sutured (Fig. 249 *b*)

This excised mas was composed of large and small blood vessels enclosing irreg ular masses of endothelial-like cells without any special formation. There were occasional mitotic figures. There was little supporting stroma.

An interval of three weeks elapsed.

Stage 2. Further Tumor Excision.

1 The previous scar was incised and elevated along the facial plane. The residual tumor was excised.

2. The bordering cheek skin was elevated to the mandible.

3 A fine needle was inserted into the large dilated capillary which was coag ulated with low voltage current. Two of these were so treated (see Fig. 249 *c*)

4 The cheek flap was advanced with strong traction, and the maximum of the remaining skin lesion was excised and sutured. The result is seen in Figure 249 *c*.

An interval of eight weeks elapsed.

Stage 3 Tumor Excision.

1 An offset—a reversed Z—incision was made in the nasal skin, centered mesial to the internal canthus and continued down the nasofacial groove and around the inferior border of the pointed normal skin flap and around the commissure of the lips. Incision was made below (⅜ inch—1 cm.) and parallel with the lower orbital rim to meet the initial incision about the tumor

2. The lid skin covering was dissected and the infra-orbital mass removed (about 1 inch—2.5 cm.—in lateral diameter)

3 The Z incision was carried through the periosteum, which was elevated with the internal canthal ligament and the lachrymal sac. Separation of the peri-orbita to the anterior ethmoidal vessels was continued.

4. The peri-orbita was incised, and the dilated vessels in the connective tissue and fat were ligated.

5 The tumor beside the ala and on the lip (½ inch—1.25 cm.) was removed.

6 The cheek flap was elevated as formerly

7 More dilated skin capillaries were coagulated with a fine, bevelled needle inserted diagonally This was a mistake, because too large a skin area about the needle was coagulated (see Fig. 249 *d*) This has since been done repeatedly with the finest dental broach inserted perpendicularly to the skin, with a resulting fine pin-sized scar

8 Traction was made on the cheek flap. Its free edge was incised at the alar level to provide the skin covering for the lip and removal of the maximum of the remaining skin lesion which was excised and sutured.

An interval of six months elapsed.

Stage 4 Excision of Skin. The remaining skin lesion (⅜ inch—1 cm.—by 1 inch—2.5 cm.) was excised.

An interval of five months elapsed.

Stage 5 Capillary Coagulation. A final coagulation of two skin capillaries was done (see Fig. 249 *e*)

Problem XI *Case XV* (Fig 250 p 375) *The healing of a third degree x-ray burn scar with slough of the fascia over the parotid duct and median branch of the seventh nerve and the ultimate replacement of this healed area and the large surrounding area of healed second de gree burn scar*

The patient was burned with a fluoroscope during sphenoid surgery three months before she was presented for repair She had a healed second degree burn extending from the temporal hair line along the anterior ear attachment to the neck below the

angle of the mandible, across the cheek to a point 1 inch (2½ cm.) from the angle of the mouth, directly superiorly to the external canthus and diagonally across the temporal area to the hair line. This area was 2½ inches (6.5 cm.) by 3 inches (7.5 cm.) in diameter. There was a third degree burn ulcer 1¼ inches (3 cm.) by 1¾ inches (4.5 cm.) in the center of this cheek area (Fig. 250 *a* p 377)

The patient returned home for treatment with radon ointment and was again presented five months later for management of the ulcer and ultimate cosmetic repair. The second degree scar had markedly improved, but the ulcer was much the same. There was an added skin inflammation and draining fistulas over the tragus.

PROCEDURE.

1 The slough was cleared with a knife handle and the scar margins of the ulcer freshened by excision. There was a fascial burn loss with exposure of the parotid duct and median branch of the seventh nerve.

Split skin from the abdomen was used to close the area.

2. The skin was reflected from the tragus, and cartilage was excised beyond the depth of the fistulas.

Both areas healed without incident.

Local skin and scar management for three months fitted the patient for cosmetic repair.

The desired repair, multiple excision with advancement of the normal neck and submental skin, was not feasible because of the risk and difficulty in repeated separation of the deep scar in a burn of this sort. The choice of procedure was replacement of the grafted area with a pedicled flap from the lower neck and the utilization of this skin around the deep scar in the grafted area for subsequent multiple excision of the extensive border scar over the area of second degree burn.

An interval of three months elapsed.

Stage 1 Excision.

1 An incision was made along the anterior and inferior borders of the graft.

2. The scar and normal skin bordering the incision were elevated.

3 Traction was applied drawing this skin over the graft without distortion of the mouth and ala. The scar was excised (about ⅝ inch—1.5 cm.) along the border of the graft and sutured, and dressed with gauze relaxation strips applied with collodion (U.S.P.)

Note the scar area in Figure 250 *b–d*

An interval of ten weeks elapsed.

Stage 2. Tubed Pedicle Flap

1 A pedicled flap was designed with its base over the sternomastoid muscle below the burn scar and its distal end above the clavicle, lateral to the attachment of this muscle. The width of the flap was 3 inches (7.5 cm.)

The anterior incision was made from the level of the hyoid bone along this muscle to its clavicular attachment. The posterior incision was carried from this point along the clavicle, then upward, parallel to the first incision, to its point of beginning and then curved posteriorly to the hair line.

2. The superior 3 inches (7.5 cm.) of this outlined skin was elevated and sutured as a tube. The bordering skin was elevated and sutured (see Tubed Flaps, p 8)

3 The remaining incision was sutured (Fig. 250 *c*)

An interval of four weeks elapsed.

Stage 3 Flap Delay. The scar bordering the flap was incised and the flap elevated, returned to its bed, and sutured.

An interval of four weeks elapsed.

Stage 4 Transfer of Flap.

1 The flap was incised and elevated.

2. The bordering skin was freely elevated, approximated and so forth in the usual manner (see Pedicled Flaps, p 8)

3 The border of the graft was incised and removed.

4 The bordering scarred skin was elevated.

5 The graft was applied and the scar incised slightly beyond its anterior border—sufficient to produce slight tension when the graft was sutured

6 Suture and dressing were accomplished (Fig. 250 d)

An interval of five months elapsed.



Fig. 250 Problem XI use of pedicled neck flaps, deep x ray burn with loss of skin and some fascia. a, The original condition b the area after split skin grafting; c the preparation of a tubed neck pedicle and flap d the result of these procedures. (See p. 375 for detailed description and procedure.)

Stage 5 Amputation of Pedicle. The pedicle was amputated from the flap the residual tube opened, and so forth, and the base skin fitted into the neck.

The bordering scar and skin around the incised flap were elevated, and the maximum of this scar excised and sutured (Fig. 250 e)

An interval of three months elapsed.

Stage 6. Scar Excision. The scar was excised in the usual manner around the anterior and inferior borders of the flap.

An interval of nine months elapsed.

Stage 7 Scar Excision. The scar was excised lateral to the external canthus and the angle of the mandible The upper and lower neck scars were revised.

An interval of sixteen months elapsed.

Stage 8 Scar Excision. The top of the flap (Fig. 250 *e*) was incised from the pre-auricular area to a point 2 cm. below the external canthus. The flap was elevated for $1\frac{1}{4}$ inches (3 cm.) along this incision. The temporal scar was elevated to the hair Traction sutures were used, and about three quarters of the scar was excised. This brought the normal skin nearly to the hair line.

COSMETIC MELOPLASTY

Cosmetic meloplasty is sufficiently justified in selected cases of various types. The reconstruction has an economic social and psychic importance as essential as the results of trauma malignancy and congenital cosmetic disabilities. The reconstructive surgeon has neither the time nor the disposition to deal with a host of patients whose purpose is purely vain. The surgery properly accomplished is not an office procedure. On the contrary it is not only a hospital procedure, but one demanding meticulous preparation proper planning to minimize scar a complete understanding of the factors producing the skin relaxation and redundancy a gentle handling of the tissue involved and both an esthetic and common sense in the correction accomplished

Small areas of elevation of the involved skin and stretching procedures to produce an immediate pleasing result should have no place in the surgeon s consideration. These have only relatively short desirable results demanding repeated care A proper management results in a long period of satisfactory skin condition but nothing can prevent a further future loss of elastic tension and the recurrence of redundancy

Procedure.

1 Preparation. The hair over the involved temporal region and posterior to the ear should be shaved the evening before surgery The skin should be thoroughly cleansed with soap and water The skin cleansing with soap and water should be repeated in surgery Soap is removed with ether It is then painted with iodine (1.5 per cent) and this removed with alcohol.

2. Anesthesia is induced with 0.5 per cent novocain containing 20 drops of epinephrine (1 1000) to the ounce This amount of epinephrine is not exceeded in the anesthetization of the two sides. It is essential that the field be practically bloodless if surgery is to progress with certainty

3 The incision should be planned and executed as in Figure 233 *a ABC* (p 345) This should curve in the temporal hair come close down the helix to the tragus, down its posterior surface to the bottom of the canal, thence out to the tragus attachment and down and back in the neck to a point below the lobe then up and backward along the posterior ear attachment to curve slightly out in the hair line This kind of incision will produce an end scar which is ultimately visible in only two short segments.

4 Elevate the cheek and neck skin as described under Multiple



Fig. 251 Cosmetic meloplasty (See p. 378 for descriptive details and procedure.)

Excision (p 341) *This elevation should completely free the skin of the cheek, except in the area about the commissure of the lips where the facial nerve emerges from the fascia below the mandible in the submental region and in the neck down to the level of the hyoid bone in cases of redundancy of the chin The elevation should include the skin posterior to the sternomastoid muscle if redundancy of the neck skin is also concerned.*

5 Make traction with a sharp hook vertically and posteriorly behind the ear *A proper traction should not obliterate the lines of expression about the nose and the lips* The line of overlapping of this retracted skin about the ear incision determines the line of excision.

6 Pass a plain single 0 anchor catgut stitch through the derma of the skin immediately below the lobule and through the strong connective tissue immediately below the canal and tie Pass similar anchor stitches in the curved incision in the temporal hair area.

7 Repair the lobule as in Figure 233 (p 345)

8 Suture the skin approximating areas with 0000 Dermalon

A redundant chin (double chin) cannot be corrected by the separation of the skin and traction as just discussed. Make a submental incision ⅜ inch (1 cm) long under the chin Curet the fat beneath the skin and above the subcutaneous fascia This is readily extruded through the incision The skin traction will then produce a satisfactory result.

Removal of the redundant skin of the eyelids (baggy eyelids) is essential to a desirable cosmetic result.

Procedure.

1 Two sutures are passed between the margins of the lids to approximate them This produces a normal surface skin tension

2 Elevate the skin from the center of the lids with four or five fine hemostats. Exert moderate traction

3 Excise the elevated skin with scissors along the midline of the upper lid from the external to the internal canthus and near the margin of the lower lid. Do not elevate the remaining lid skin.

4 Close the defect in the remaining lid skin with fine interrupted or continuous dermal or silk sutures

5 Remove the lid stitches from the margin

Dress the lids and the face with fluffed gauze under moderate pressure to prevent serum collection and edema These dressings are well held in place by applying a long folded strip of gauze with collodion (U S.P) in the submental region, passing this over the sides of the face and tying over a pad on the top of the head

or central injury The disability may or may not include the superior rectus muscle

Procedures. The operative procedures of which there are more than fifty are of three types

1 Shortening of the levator muscle and excision of skin and tarsus. This is useful only in Group 1 of congenital ptosis (Panas)
2 Attachment of the lid to the frontalis muscle
   (a) Silk or linen stitches (Pagenstecher)
   (b) Flaps
      (1) Skin and orbicularis oculi muscle (Maschek-Gifford)
      (2) Orbicularis oculi muscle only (Reese)
   (c) Fascial strips (Blair)
3 Use of the superior rectus muscle to elevate the lid (Trainor, Motais Greeve)

Maschek's Operation for Ptosis Modified by S R. Gifford A horizontal incision, including skin and orbicularis oculi muscle is made 6 mm. (3 mm. Gifford's) above the free margin of the lid, extending almost to the outer and inner canthi (Fig. 252 c) Gifford's incision stops 3 mm short of each canthus to avoid resistance of the internal and external palpebral ligaments (Fig. 252, c) A second incision, slightly longer than the first, is made 5 mm. above it. In the moderate case this incision is made 4 mm. above the first in order that the resultant skin fold will fall into the same plane as the normal. The higher the incision (wider flap) the greater the elevation obtained.

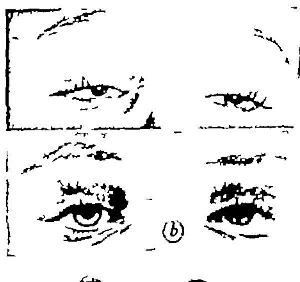
The rectangular flap formed by these incisions is cut in the middle, leaving it attached at each end (Fig 252, c) The flaps are drawn in different directions to determine the best line of traction for the desired elevation Tunnels through the brow and lid are made in the selected direction by blunt dissection through small incisions along the upper margin of the eyebrow The epithelium is removed from the skin of the flaps by scraping and painting with trichloracetic acid The flaps are drawn through the tunnels and fixed to the *frontalis* muscle with a stitch (Fig. 252 c)

A cone made from a cleaned roentgenographic film is placed over the eye and fixed to the skin with adhesive tape around its free edge This should make an air-tight seal Moisture collects in the cone and prevents drying of the cornea.

The *Reese* procedure departs from what has just been described by inclusion of muscle only (no skin) and cutting of the ends of the flap so that it remains attached to, and elevates the middle of the lid.

Fig. 252. Maschek-Gifford operation for unilateral or double ptosis. *a*, Appearance of a patient with unilateral ptosis (uppermost photograph) and after (two lower photographs) operation. *b* Appearance of patient with bilateral ptosis before (upper photograph) and after (lower photograph) operation, final picture 5 years after operation. *c*, The curved, dotted lines, *AB* locate Gifford's incision, the curved, solid lines outline Maschek's incision, the diagonal, dotted lines, *C* locate the general position of the supporting flaps, which are sutured into the frontalis muscle.


a)


(b)

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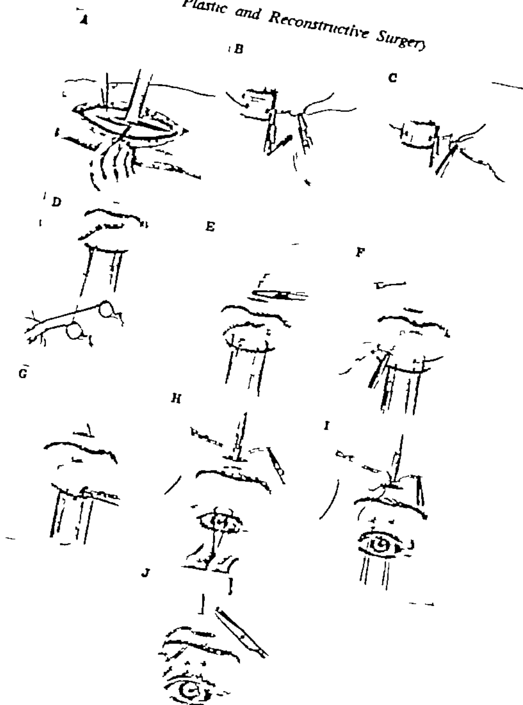


Fig. 253 Ptosis. Support with implanted fascial strings *A* Cutting the fascial strips this was the original procedure fascia is now obtained with a Masson stripper *B* and *C* Fixing the fascial thread in the carrier needle. *D* Traction sutured dotted lines represent incisions in brow and lid. *E* First insertion of the carrier needle. *F* Second insertion of carrier needle the fascial strip is sutured to the tarsus with fine silk at this and the next insertion, to prevent puckering when the strings are fixed on tension in the frontalis muscle *G* Third insertion of carrier needle fascia is fixed with silk at this point. *H* Single tension knot held with a hemostat. *I* Fixation of the knot with a silk stitch *J* Insertion of fascial ends in frontalis muscle, burying the ends. (Blair Brown and Hamm Arch. Ophth. June, 1932.)

Blair Brown and Hamm Operation Some action of the occipito-frontalis muscle suggests attaching fascia to it

OBTAINING THE FASCIA The fascia is cut from the iliotibial band (Fig. 253 *A*) Clear away the fat until the longitudinal fibers are plainly seen Incise along the anterior part of the band for the desired length Free the fascia from the underlying muscle protect with a spatula With a *sharp knife* cut several strands 2 to 3 mm wide and 1 to 15 cm long Close the fascia with catgut the skin with running suture The fascia can be obtained better with a stripper (p 134)

FIXING THE FASCIA STRIP TO A NEEDLE A slender curved needle with a moderately large eye, is passed into a sterile moist pad and held with needle forceps (Fig. 253 *B*) A second fine curved needle is threaded with No 000 silk (Fig 253 *B*) The point of the fine needle which is grasped with needle forceps serves to push the fascial strip through the eye of the larger needle The end drawn through the eye of the needle is fixed to the main strand with fine silk (Fig. 253 *C*)

SURGICAL PROCEDURE Insert an eye protector beneath the lid Fix and exert tension on the lid by passing two silk sutures through the inferior margin of the tarsus. Pass the threads through the rings of two ordinary anchored hemostats and weight the threads with hemostats at their ends (Fig. 253 *D*) Make a transverse incision 1 cm long, through the scalp at the point of greatest action of the frontalis belly of the muscle (Fig. 253 *D E*)

Two stab cuts 1 cm apart are now made in the skin of the lid in the crease that normally traverses it, slightly above the tarsal border The midpoint of these two cuts should mark the highest elevation of the lid (Fig. 253, *E*) Pass the carrier needle subcutaneously from the outer angle of the upper incision through the corresponding lower incision Keep the fascial strand in a gauze sponge moistened with saline solution *Guard against contamination* (Fig 253 *E*) Reinsert the carrier so that it will engage the upper border of the tarsus and emerge *from the second cut (Fig 253 F) Guard the strip from contact with the eyelashes*

Blair now fixes the fascial string to the tarsus with a silk stitch passed through each of the incisions in the lid. This prevents puckering when the ends are tied into the frontalis muscle on tension

Reinsert the carrier so that it will emerge from the inner angle of the incision in the scalp (Fig 253 *G*) Relax the traction threads Tie a single knot (twist) in the strands. This knot is drawn into the incision when the desired elevation of the lid is obtained. Fix the knot with a fine hemostat thrust into the depth (Fig 253 *H*) Test the length and tension of the loop by traction on the silk threads while the forceps on the twist are so held as not to influence the tension Fix the knot, after drawing it out of the wound with fine silk sutures (Fig. 253 *I*) Pass the free ends of the strands beneath the scalp draw them tense and cut them at the surface of the scalp They will retract out of sight (Fig. 253 *J*)

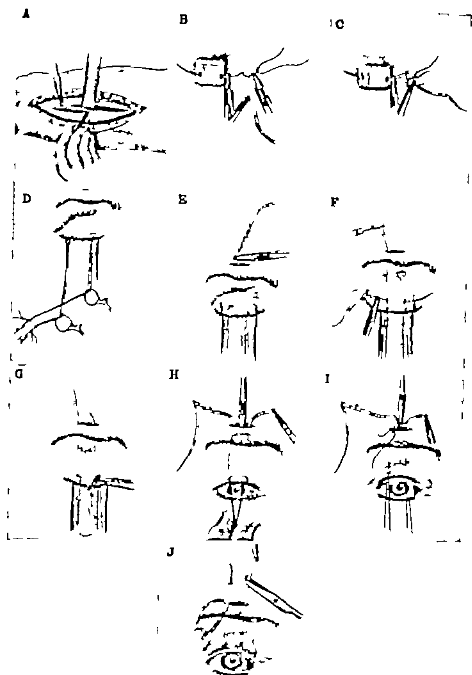


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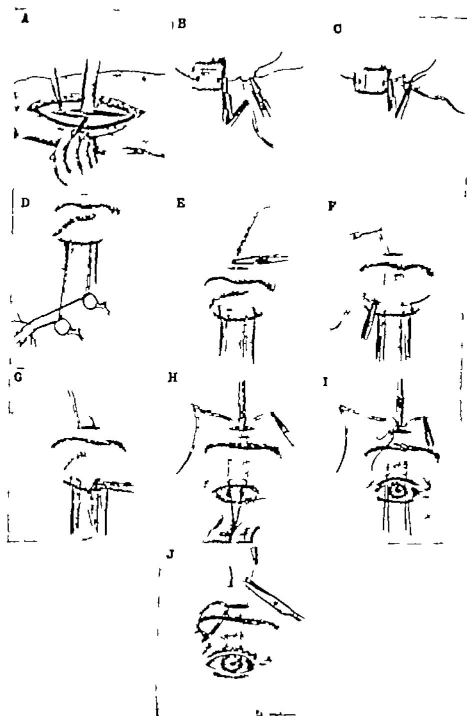


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Two stab cuts 1 cm. apart, are now made in the skin of the lid in the crease that normally traverses it slightly above the tarsal border The midpoint of these two cuts should mark the highest elevation of the lid (Fig. 253, *E*) Pass the carrier needle subcutaneously from the outer angle of the upper incision, through the corresponding lower incision. Keep the fascial strand in a gauze sponge moistened with saline solution *Guard against contamination* (Fig. 253 *E*) Reinsert the carrier so that it will engage the upper border of the tarsus and emerge from the second cut (Fig 253 *F*) *Guard the strip from contact with the eyelashes*

Blair now fixes the fascial string to the tarsus with a silk stitch passed through each of the incisions in the lid. This prevents puckering when the ends are tied into the frontalis muscle on tension

Reinsert the carrier so that it will emerge from the inner angle of the incision in the scalp (Fig. 253 *G*) Relax the traction threads Tie a single knot (twist) in the strands This knot is drawn into the incision when the desired elevation of the lid is obtained. Fix the knot with a fine hemostat thrust into the depth (Fig 253 *H*) Test the length and tension of the loop by traction on the silk threads while the forceps on the twist are so held as not to influence the tension. Fix the knot, after drawing it out of the wound with fine silk sutures (Fig. 253 *I*) Pass the free ends of the strands beneath the scalp draw them tense and cut them at the surface of the scalp They will retract out of sight (Fig 253 *J*)

Close the incisions with fine interrupted sutures Dress with cotton eye pads for twenty four hours. Keep the eye covered with an airtight cone until all reaction has subsided.

Figure 254 represents the result that can be obtained by use of the operation which is the subject of Figure 253

Trainor s Operation The results obtained with this operation are represented in Figures 255 and 256 (the latter by courtesy of Dr Trainor)

PROCEDURE Evert the upper lid (Fig. 257 *A*) Make an incision 2 mm deep at the junction of the outer third and fourth quarter of the lid. This incision is made perpendicular to the tarsal margin (Fig. 257, *A*) Turn the scissors and cut parallel to the tarsal margin for 7 to 10 mm. to the junction of the first and second quarters of the lid (*Fig* 257 *B*) *This makes a tongue of the fibrous plate covered by*

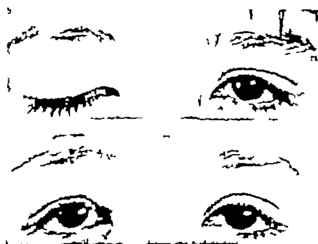


Fig. 254 Unilateral ptosis before and after correction with fascial support (Blair)

conjunctiva on both sides Make an incision on each side of the superior rectus muscle, leaving the conjunctival covering intact (Fig. 257 *C*) Insert a squint hook under the muscle Pull the eye down. Enlarge the opening under the muscle to admit a small hemostat. Insert this hemostat from the temporal side Grasp the tarsal tongue and pull it under the superior rectus muscle Stitch it in its original position with one fine silk suture (Fig. 257 *D*)

Turn the lid down in its normal position It is frequently overcorrected. This can be adjusted by tension on the lid to pull it down or by everting the lid again and lengthening the tongue A silk suture fixing the tongue to its original attachment on each side of the muscle tendon produces maximal elevation. Close the lids with one or two sutures and allow them to remain so for twenty-four to forty-eight hours. Trainor recommends that no dressing be applied.

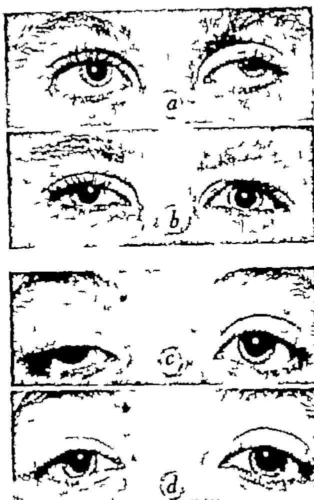


Fig. 255 Ptosis (Trainor's procedure) *a* Before and *b* after operation this lid is slightly overcorrected *c* Before and, *d* after operation.



Fig. 256 Unilateral ptosis. *Above* Before and, *below* after correction. (Courtesy of Dr Trainor)

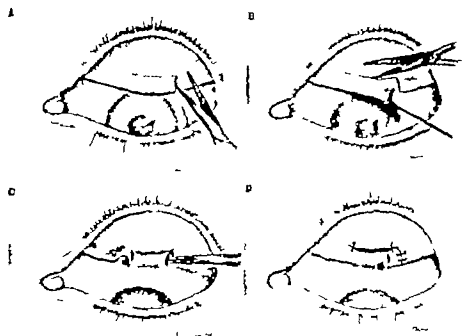


Fig. 257 Ptosis. Trainor operation. *A* Incision 2 mm. long, at a right angle to the superior border of the tarsal plate *B* incision extended parallel to the superior border of the tarsal plate; *C* tongue-shaped flap, resulting from the incisions represented in *A* and *B* being drawn under the superior rectus muscle; *D* flap stitched in its original location.

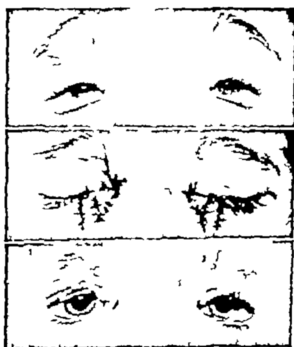


Fig. 258. Mechanical ptosis and epicanthus caused by shortness of the lower lid. *Top* Extreme effort to elevate the lids *middle* lengthening of the lids with interpolated nasal skin flaps *bottom* result of lengthening of lids.

EPICANTHUS

Epicanthus consists of a fold of skin covering the inner canthus to a greater or lesser degree It may be of congenital or traumatic origin. The fold of skin is produced by the traction or vertical shortness of its free rolled edge Traumatic epicanthus results from local loss of tissue and scar contraction or from a similar process in the eyelids The condition may limit the movement of the upper lid to produce definite ptosis (Fig. 258 *top*)

Correction is obtained by lengthening the vertical dimension at the expense of the redundant horizontal one This is effected by Z plastic operations (Fig. 259) the shifting of various-shaped flaps locally or the interposition of new tissue, pedicle flaps or free grafts

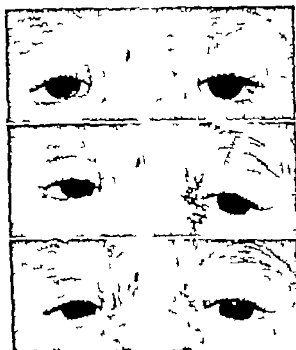


Fig. 259 Bilateral ptosis epicanthus. Correction of one side by Z plastic operation.

"Mechanical" Ptosis and Epicanthus. The condition contemplated here results from shortness and narrowness of the lower lid The condition pictured in Figure 258 is congenital. It may be acquired by loss of substance of the lower lid.

Procedure Make an incision just lateral to the punctum to separate the conjunctiva along two thirds the length of the lid. Incise the skin and underlying tissue to the conjunctiva along a vertical line 2 or 3 mm lateral to the punctum A defect of V shape defines the size of the required addition. Cut a flap of desired dimensions from the lateral surface of the nose mesial to the canthus. Transpose the flap Approximate the flap and margins of the defect in the lid with inter

rupted sutures of horsehair Close the defect in the nasal skin in a similar manner (Fig 258, *middle*)

Note the strong traction of the frontalis muscles in Figure 258 *top* with residual ptosis and epicanthus. Contrast with Figure 258 *bottom*.

Correction of Epicanthus by Z Plastic. The average case is readily and simply corrected with a Z plastic This does not, of course apply to cases of deficient horizontal lid length. The vertical shortness evidenced by the skin fold over the canthus is easily corrected to the desired and predetermined length (Fig. 259)



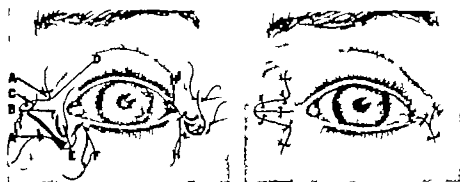


Fig. 260 Epicanthus and short palpebral fissure. *Upper* Lines of incision for correction. *Lower left* Disposition of flaps points of suture. *Lower right* Completion of the correction. Letters on the face of the drawing are explained in the text. (Blair Brown and Hamm Arch. Ophth., June, 1932.)

Procedure

1 Make the central arm incision parallel to and mesial to the fold. It should center at the canthus

2 Incise the upper arm mesially and the lower one laterally at a sufficient angle, up to 70 degrees, to provide the desired increased length (see Z Plastic, p 221)

3 Elevate, transpose and suture the flaps with 00000 Dermalon.

4 Remove the sutures on the second or third day and support with gauze strips applied with collodion (U S.P)

Correction of Epicanthus and Short Palpebral Fissure (Blair): *Procedure* Make the horizontal incision *AB* in Figure 260 *upper* (the dotted lines represent the incisions the heavy black lines indicate only the

points where the letters apply) This incision is 8 mm long and begins at a point 5 mm from the canthus. The incision is carried down to the inner canthal ligament, but not through it. Make incisions AC and A^1E curving temporarily both upward and downward from the starting point A (5 mm from the canthus) These incisions are 7 mm long (Fig. 260, *upper*) From the terminations of these incisions (C and E) make incisions to points D and F on each lid 4 mm from the canthus (Fig. 260 *upper*) Dissect and transpose the flaps thus described, C and E approximate B A approximates D A^1 approximates F Close the approximating edges with interrupted sutures of horsehair

Apply a cotton eye pad and strips of adhesive tape Remove all stitches, except those at the nasal angles of the flaps, on the second day Support with gauze strips applied with collodion

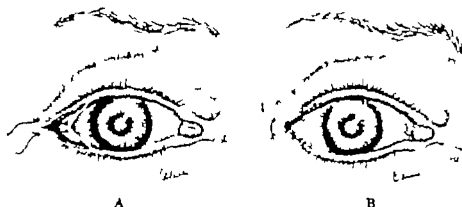


Fig. 261 Canthoplasty (von Ammon) *A* Incision of skin and conjunctiva at external canthus, location of a mattress fixation suture. *B* Final enlargement of palpebral fissure cutaneous-conjunctival sutures.

Canthoplasty *Procedure* Make an incision beginning at the canthus (G and G^1 of Fig. 260 *upper*) and running laterally 3 or 4 mm. cutting the external canthal ligament, curving downward and outward for about 6 mm. and then curving upward to terminate about 7 mm lateral to, and 5 *mm.* above, the canthus Dissect the flap I (Fig. 260, *upper*), but do not dissect the skin margin continuous with the lower lid.

Undermine the conjunctiva with scissors and stitch the conjunctiva with silk to the skin of the lower lid at the point of desired canthal opening H (Fig. 260 *lower left*) Stitch the conjunctiva to the upper lid further laterally than below *to provide the relaxation of the upper lid* that will be necessary to permit its raising (note new location of H^1 in Fig. 260 *lower left*) Approximate the skin at the points of conjunctival attachment to form the new canthus Close the approximated skin edges with interrupted horsehair sutures (Fig. 260 *lower right*) Dress as for correction of epicanthus and short palpebral fissure.

Von Ammon's Method The purpose here is to widen the palpebral fissure

PROCEDURE Hold the outer commissure open with the thumb and finger Push one blade of a strong scissors into the outer cul-de-sac, as far as it will go The blade must be *exactly* in the line of the closed palpebral fissure Make a cut 10 to 15 mm long. Divide the external canthal ligament. Make traction upward and inward on the margin of the upper lid to open the incision between the skin and conjunctiva and to cause tension of the ligament. Introduce the scissors and cut the ligament that is under tension at a right angle to the incision in the skin. Repeat this below Pass a mattress suture below the angle of the conjunctiva and through the skin on each side of its angle (Fig. 261 *A*) Tie Approximate the remainder of the conjunctiva and skin with interrupted silk sutures.

ECTROPION

Ectropion is an eversion of the margin of either the upper or the lower lid or both Ectropion of the lower lid causes epiphora and irritation of the exposed conjunctiva ectropion of the upper lid results in lagophthalmos, which if marked, may lead to loss of the eye

Types. Ectropion is either cicatricial or paralytic in origin The *cicatricial* type results from loss of tissue and the subsequent scar contraction The *paralytic* type results from paralysis of the orbicularis muscle (seventh cranial nerve) It begins with slight eversion of the margin of the lid, which finally sinks of its own weight as the muscle degenerates from disuse It is ultimately accentuated by chronic catarrh and the disposition of the muscle below the inferior border of the tarsus.

Procedures. Several satisfactory procedures are available for correction of cicatricial ectropion The most satisfactory results judged from all standpoints result from (1) replacement of the lost tissue with a rotated flap from either the nasal or the temporal border of the lid or (2) correction of the defect caused by the loss of tissue either with full thickness skin removed from a normal lid, or with skin from the mesial surface of the ear This skin is utilized according to the technic of Wheeler The epithelial outlay (Esser) does not produce so pleasing a cosmetic result as the procedure just mentioned.

Full Thickness Skin Graft for Ectropion (*Wheeler's Technic*) PROCEDURE Stage 1 Make an incision about 3 mm. from the margin of the lid from a point slightly outside the canthus on one side to a similar point on the other Dissect the conjunctiva free until the lid lies at its normal level. Undermine the bordering scar until the skin lies without tension. Pare the epithelial surface from the margins of the lid at opposing points in the middle of the lids and at the junction of their outer and inner first and second quarters, for a length of 3 mm (Fig. 262 *e*) Pass horizontal mattress sutures of silk through the two lids in a manner to approximate these raw surfaces (Fig 262 *e*) Tie the sutures sufficiently tight to approximate the lids gently and at the same time to make allowance for subsequent swelling without cutting A small block from the wall of a rubber tube can be placed under these sutures as they

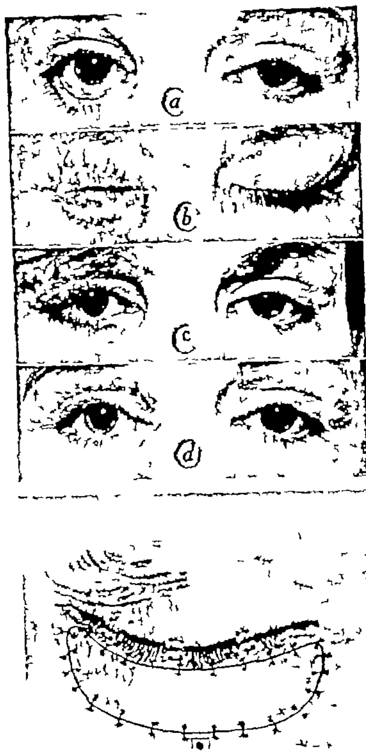


Fig. 262. Ectropion of the lower lid (Wheeler) *a*, Condition (eye open) before correction. *b* Appearance on first removal of dressing (twelve days) skin graft taken from the upper lid used to cover lower lid horsehair sutures in upper lid, surgical adhesion. *c* Appearance 60 days after operation surgical adhesion between the lids. *d* Result one year after operation. *e* Adjacent raw surfaces of the upper and lower lids approximated with horizontal horsehair sutures to produce surgical adhesion: skin graft on lower lid simple suture.

cross the skin to prevent cutting, but is unnecessary if proper care is exercised in tying them.

Make a pattern of the defect in the skin Excise full thickness skin of this exact pattern from a normal upper lid, if size permits, or from the skin on the mesial surface of the ear (Fig. 262 *b e*) Approximate

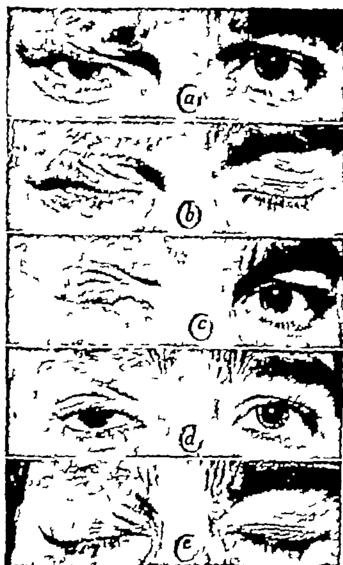


Fig. 263 Ectropion of the upper lid. *a*, Eyes open *b* eyes closed *c* eyes open 30 days after repair with a full thickness graft taken from the back of the ear surgical adhesions fixing the lids. *d* and *e* Four months later eyes open and closed.

the edges of the graft to the edges of the defect with interrupted sutures of fine horsehair (Fig. 262 *b e*) Tie the sutures lightly but sufficiently *to approximate the edges.*

Instil boric acid ointment beneath the lids Cover with a cotton eye

pad and fluff gauze Apply a firm bandage and supplement this with strips of adhesive tape This dressing should remain unopened for twelve days (p 25)

Stage 2 An interval of twelve days is allowed to elapse between Stages 1 and 2 Open the dressing, remove the stitches, and again apply a dressing under moderate pressure at intervals for several days The support of this dressing aids materially in the safe growth of the graft for several days subsequent to opening the original dressing.

The surgical adhesions between the lids remain for sixty to ninety days, or longer depending on conditions. Complete organization of scar never occurs sooner than six weeks and frequently requires a longer period. The surgical adhesions may be so disposed in certain cases as to permit some vision through the central portion of the lids (see Figs 262 *c* 263, *c*)

Paralytic Atrophic Ectropion (Palsy of Seventh Cranial Nerve) The following procedure removes the redundancy of the lower lid and furnishes a fixed mechanical support in those cases wherein it has been impossible to restore function of the nerve

Procedure Make an incision on the conjunctival surface of the lid, beginning at a point 2 mm. lateral to the punctum and extending to the opposite canthus, to separate the skin from the underlying tissue This incision should avoid the follicles of the eyelashes (Fig. 264 *A*) Remove a wedge shaped piece of musculotarsoconjunctival" layer of sufficient size to put the conjunctiva under tension and to hold it firmly against the globe (Fig. 264 *A*) Close the defect with several interrupted sutures of fine silk (Fig. 264, *A*)

Obtain a strip of fascia lata 2 mm wide and 15 to 20 cm long as described on page 134 Pass this about the lids and fix it in the temporal muscle for permanent support, as described on page 315 (Fig. 209 *top*) Make a right angle incision through the skin at the outer canthus, as pictured in Figure 264, *B* Make lateral traction on the skin of the lid until it snugly approximates the lining layer Remove the excess skin and approximate the opposing edges as pictured in Figure 264 *C*

Close the lids by applying several strips of fine mesh gauze across them and fixing them with collodion Instil boric acid ointment beneath the lids Apply a cotton eye pad fluff gauze and a firm bandage This dressing pressure should be maintained for several days until the reaction to the implanted fascial strip has subsided.

ENTROPION

Types. This condition may be of spastic or contractile origin. The *spastic* variety results from spasm of the orbicularis oculi muscle Any condition which causes pressure of the lid against the eyeball is an aggravating factor (bandage pressure blepharophimosis and so forth) Contraction of the subtarsal muscle *turns* the edge of the lid inward so that the lashes irritate the cornea. *Cicatricial* entropion results from

cross the skin to prevent cutting, but is unnecessary if proper care is exercised in tying them.

Make a pattern of the defect in the skin. Excise full thickness skin of this exact pattern from a normal upper lid, if size permits or from the skin on the mesial surface of the ear (Fig. 262 *b e*) Approximate

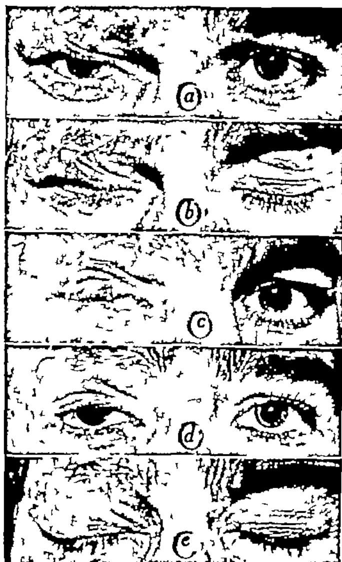


Fig. 263 Ectropion of the upper lid. *a*, Eyes open, *b* eyes closed, *c*, eyes open 30 days *after repair with a full thickness graft taken from the back of the ear* surgical adhesions fixing the lids. *d* and *e* Four months later eyes open and closed.

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Close the lids by applying several strips of fine mesh gauze across them and fixing them with collodion Instil boric acid ointment beneath the lids. Apply a cotton eye pad, fluff gauze and a firm bandage. This dressing pressure should be maintained for several days until the reaction to the implanted fascial strip has subsided.

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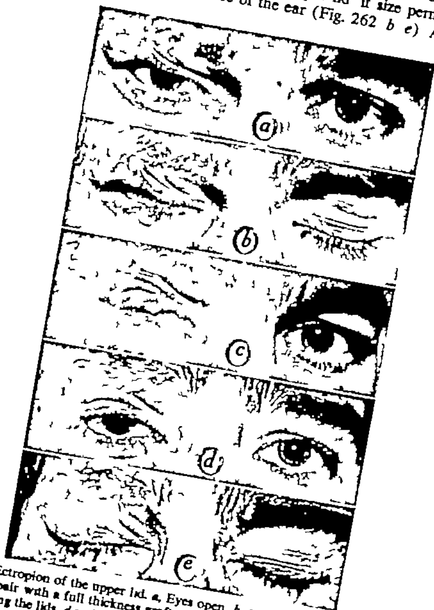


Fig. 263 Ectropion of the upper lid. *a*, Eyes open *b* eyes closed, *c*, eyes open 30 days after repair with a full thickness graft taken from the back of the ear surgical adhesions fixing the lids. *d* and *e* Four months later eyes open and closed.

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Instil boric acid ointment beneath the lids Cover with a cotton eye

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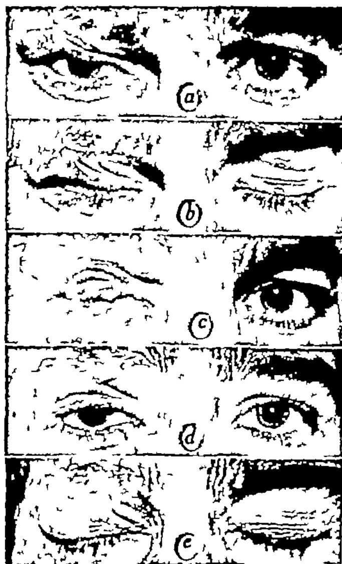


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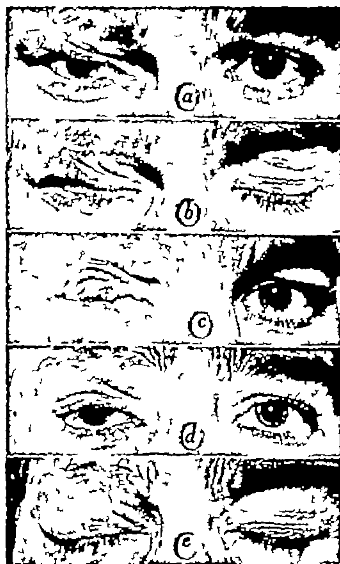


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The surgical adhesions between the lids remain for sixty to ninety days or longer depending on conditions Complete organization of scar never occurs sooner than six weeks and frequently requires a longer period. The surgical adhesions may be so disposed in certain cases as to permit some vision through the central portion of the lids (see Figs 262 *c* 263 *c*)

Paralytic Atrophic Ectropion (Palsy of Seventh Cranial Nerve) The following procedure removes the redundancy of the lower lid and furnishes a fixed mechanical support in those cases wherein it has been impossible to restore function of the nerve

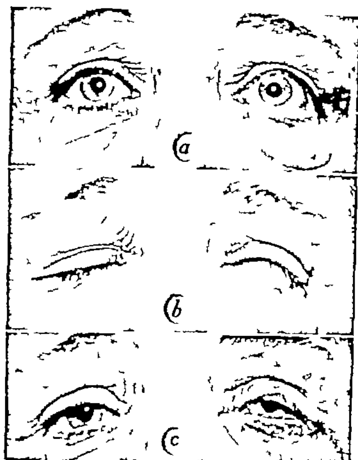
Procedure Make an incision on the conjunctival surface of the lid, beginning at a point 2 mm. lateral to the punctum and extending to the opposite canthus, to separate the skin from the underlying tissue This incision should avoid the follicles of the eyelashes (Fig. 264 *A*) Remove a wedge-shaped piece of "musculotarsoconjunctival" layer of sufficient size to put the conjunctiva under tension and to hold it firmly against the globe (Fig. 264 *A*) Close the defect with several interrupted sutures of fine silk (Fig 264 *A*)

Obtain a strip of fascia lata 2 mm. wide and 15 to 20 cm long as described on page 134 Pass this about the lids and fix it in the temporal muscle for permanent support as described on page 315 (Fig 209 *top*) Make a right-angle incision through the skin at the outer canthus as pictured in Figure 264 *B* Make lateral traction on the skin of the lid until it snugly approximates the lining layer Remove the excess skin and approximate the opposing edges as pictured in Figure 264 *C*

Close the lids by applying several strips of fine mesh gauze across them and fixing them with collodion Instil boric acid ointment beneath the lids. Apply a cotton eye pad, fluff gauze and a firm bandage This dressing pressure should be maintained for several days until the reaction to the implanted fascial strip has subsided.

ENTROPION

Types. This condition may be of spastic or contractile origin. The *spastic* variety results from spasm of the orbicularis oculi muscle Any condition which causes pressure of the lid against the eyeball is an aggravating factor (bandage pressure, blepharophimosis, and so forth) Contraction of the subtarsal muscle turns the edge of the lid inward so that the lashes irritate the cornea. *Cicatricial* entropion results from



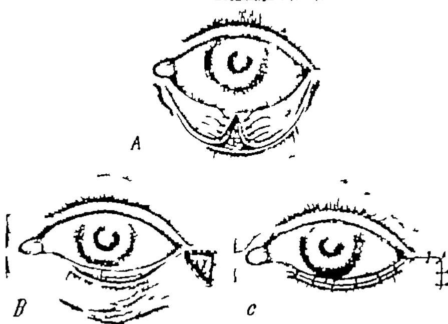


Fig. 264 Paralytic ectropion. *a* and *b* Condition before operation, with eyes open and closed. *c* Condition six days after operation. *A* Kuhndt procedure separation of skin from underlying tissues removal of a suitable wedge from the musculoconjunctival layers sutures placed. *B* Musculoconjunctival layer closed with fine silk sutures; triangular excision of skin to remove excess skin of lid. *C* Final repair

any condition which produces deep scar in the tarsus and conjunctiva and its subsequent contraction (burns, trauma and so on) The tarsus is bent at a sharp angle

Spastic Entropion A method of cauterization described by Ziegler is an efficient and simple way to relieve this condition immediately Scar is created to hold the skin to the bottom of the tarsus. This causes the contraction of the orbicularis muscle to press the lower border of the tarsus against the globe rather than to pull the tarsus up and outward to evert the margin of the lid.

PROCEDURE. A local anesthetic agent is injected under the skin along the entire length of the lid An assistant holds the patient s head against him and pulls the lid down by making firm traction on the cheek below it.

Insert a bone spatula behind the lid to protect the eye An electric cautery point, heated to a red glow is used to puncture the skin and subcutaneous tissue to a depth of 3 mm at the midpoint of the lid

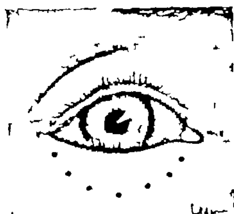


Fig. 265 Entropion. Location of points of cauterization.

about 8 mm below its margin Other punctures are made on both sides of the first one (Fig. 265) each approaching nearer to the margin of the lid They should mark a line a little below the lower border of the tarsus. Apply compresses to control the swelling No dressing is necessary

Cicatricial Entropion Numerous corrective procedures have been described Two of them seem to produce the best results if excessive loss of conjunctiva has not taken place

WIENER'S METHOD This procedure is applicable in all cases in which the lower lid is affected and in cases in which the upper lid is affected if there is considerable narrowing of the tarsus

Procedure Instil one or two drops of solution of cocaine to anesthetize the eye Evert the lid and balloon the retrotarsal fold with solution of *procaine* to which epinephrine has been added. Inject this solution also between the tarsus and the skin

Pass four traction sutures One is placed at the midpoint of the mar

gin of the lid so as to include the edge of the tarsus, one at the midpoint of the superior edge of the tarsus, and one at each side through the edge of the tarsus (Fig 266 *upper*)

Incise through the conjunctiva and tarsus *to* the skin along the whole length of the tarsus and about 1.5 mm. from the margin of the lid (Fig. 266 *upper*) Pass five horizontal mattress sutures from the conjunctival edge farthest from the margin of the lid through the skin just above the cilia (Fig 266 *lower left*) Remove the traction sutures and

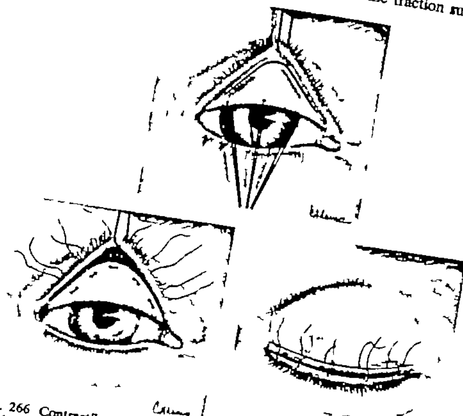


Fig. 266 Contractile entropion. *Upper* Traction stitches in the margins of the lid and tarsal plate line of incision through the conjunctiva and tarsus to the skin. *Lower left* Mattress sutures through the conjunctival edge, covering the tarsus and the skin above the cilia. *Lower right* Mattress sutures tied over a piece of heavy braided silk to evert the margin of the lid. (After Wiener and Alvis Surgery of the Eye.)

turn the lid down. Lay a piece of heavy braided silk between the mattress sutures and tie loosely the first part of the knot. Stop any oozing by sponge pressure Tie the sutures permanently (Fig. 266 *lower right*) Apply a light dressing for twenty-four to forty-eight hours

HOTZ S METHOD Select a clamp that will include the entire length of tarsus protect the eyeball and control bleeding.

Procedure Make an incision *through the skin* the entire length of the lid parallel to and about 2 mm. above the margin of the lid

(Fig. 267 *a*) Dissect the skin from the underlying orbicularis muscle to the upper border of the tarsus. Dissect the skin of the lower flap from the underlying soft tissues. Traction upward by a sharp hook in the tarsus facilitates the dissection by outlining its lower border Keep the knife close to the surface of the tarsus Avoid "buttonholing" the conjunctiva Avoid the hair follicles keep them with the lower flap (Fig 267 *a*) This step in the procedure requires care and patience

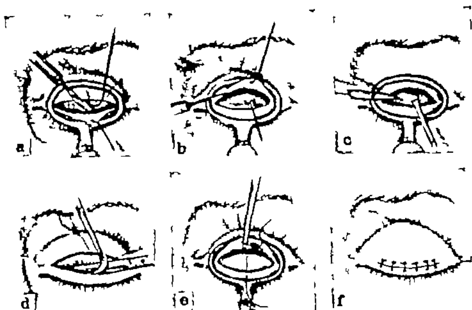


Fig. 267 Contractile entropion (Hotz) *a*, Incision in the skin along the lower border of the tarsus, above the hair follicles *b* skin flap retracted upward and tarsus downward an incision is carried through the fascia and orbicularis muscle, along the upper and lower borders of the tarsus *c* the fascia and orbicularis covering the tarsal plate are dissected off with scissors *d* an incision has been made in the tarsus 1.5 mm. above its border the outlined tarsal strip is removed with sharp scissors *e* a silk stitch is passed through the skin at its midpoint, through the upper edge of the tarsus and through the skin of the upper flap at its midpoint four similar sutures are passed, two on each side of this first suture *f* sutures tied to effect eversion of the margin of the lid. (After Wiener and Alvis Surgery of the Eye.)

Incise through the fascia and orbicularis muscle around the borders of the tarsus This incision is carried to the tarsus (Fig 267 *b*) Grasp the muscle and fascia with flat tissue forceps and strip them from the tarsus This is readily accomplished to leave a white, smooth surface over the length of the lid (Fig. 267 *c*) The upper and lower borders must be clearly visible

Make an incision with a sharp knife 1 mm above and parallel to the lower margin of the tarsus. This incision is kept in the substance of the tarsus in order to avoid damage to the conjunctiva (Fig. 267, *d*) Grasp the tarsus at one end of this incision and complete the incision with sharp scissors (Fig. 267 *d*) This narrowing of the tarsal plate allows the margin of the lid and the lashes to become everted around

this edge without undue tension on the stitches. This is the method of choice in the presence of a wide tarsus.

Pass five silk sutures in the following manner: Use a full curved cutting needle. Pass the stitch through the middle of the lower skin flap. Elevate the upper border of the tarsus with a sharp hook and pass the needle so as to include 1 mm. of this edge. Pass the needle through the margin of the upper flap (Fig. 267 *e*). Tie the first half in a knot. Repeat this procedure with two stitches on each side of the first one.



Fig. 268. Extensive laceration of both lids.

Remove the clamp. Control bleeding by firm pressure with a gauze sponge. Pull the stitches with moderate firmness. The stitches must be pulled sufficiently tight to evert the margin of the lid and the lashes. Tie the permanent knots. Use an eye pad and a moderately firm bandage for twenty-four hours (Fig. 267 *f*).

A wedge-shaped strip, base anterior, should be excised also from the entire tarsus if the cicatricial deformity is marked (Streatfield).

LACERATIONS

Incised Wounds without Tissue Loss. Wounds involving the skin or the skin and muscular layers only should not be approximated in either vertical or horizontal straight lines. This does not, of course, apply to small areas. The suture line should be staggered as in a Z plastic to pro-

vide short, opposing lines of the certain scar contraction and to prevent the occurrence of a notch or ectropion

Wounds involving the entire lid layers and its free margin demand the same consideration of scar contracture. Wheeler emphasized this in his correction of coloboma

The mucosa is sutured with fine silk the incised tarsus with 000000 plain catgut, and the skin muscular layer with fine silk or 00000 Dermalon. These suture lines should not be superimposed (scar retraction) and the skin suture line should be offset as described. Further, it is wise to slightly incise 1 mm. just above the hair bearing lid margin on either side and slightly evert these bits of lid margin with a stitch to prevent notching (see Coloboma Fig. 269, p 402)

Severance or dislocation of the tarsal plates, either mesially or laterally, demands immediate restoration. Failure to do this results in difficult later corrections. This is particularly true in fracture and displacement of the bone and raphe at the external canthus. In the case of severance the ligaments should be carefully sutured in place with 000000 plain catgut

The continuity and attachment of the levator muscle should be determined and similarly sutured if severance has occurred.

Incised Wounds with Tissue Loss. The correction of the several types and locations of tissue loss is not accomplished by a fixed technical procedure This repair should be planned and begun as soon as the vascular and cellular reaction to the trauma will permit. See the following discussion of Colobomata for satisfactory plans of management.

COLOBOMATA: CONGENITAL AND ACQUIRED

Congenital Lesions

Correction of the congenital lesion of coloboma depends upon obtaining good closure of the tarsal-conjunctival and skin-muscular layers without superimposed scar lines. Further these scar lines should be offset or staggered to prevent the certain scar contraction along a single line Wheeler recognized the principles involved and managed them well in his "halving operation." These are the basic requirements in obtaining fine lid and facial scars—in preventing retraction and contraction of approximated tissue lines He pointed out the value of sectioning the orbicular muscles, external canthotomy and the removal of a skin triangle based on the canthotomy incision lateral to the lower lid.

Finally, he recognized the obvious value of offsetting the lines of the skin scar, much as is done in the Z plastic. He incised a small rectangular bit on the lower half of the medial skin flap and excised a similar rectangular bit on the lateral side for its reception

This plan is adequate for all but gross defects

Procedure.

1 Incise cleanly the margins of the defect.

2. Separate the skin-orbicularis muscle layer from the tarsal-conjunctival layer by blunt dissection with a curved scissors.

3 Perform external canthotomy and transect subepithelially all orbicularis fibers in this part of the lid

4 Close the tarsal gap Pass several 00000 plain catgut sutures (three to six) through the tarsus only Tie a triple knot and cut short.

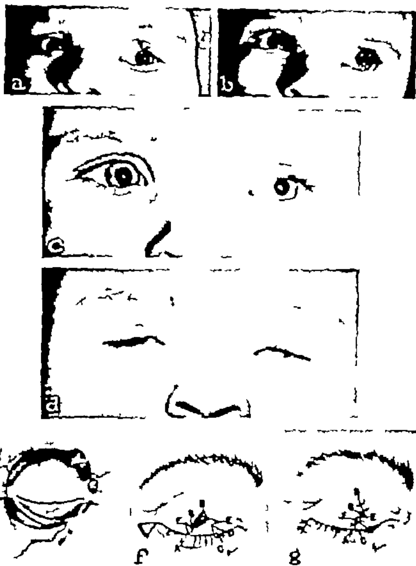


Fig. 269 Coloboma in the nasal half of the lid, *a* and *b* The original condition, *c* and *d* the repair The method of repair is the author's use of a modification of the Hagedorn cleft lip technic which is presented diagrammatically in *e f* and *g* and discussed in detail on page 663

5 Make a medial incision 3/16 inch (5 mm.) long in the skin on the median side from its midpoint. Extend this incision diagonally upward to the apex of the defect.

6 Make a similar incision on the lateral side from the midpoint downward to the edge just above the hair line on the lid margin Make

a small lateral incision (1 mm) at this point to permit eversion of the lid margin Repeat this incision on the mesial side

7 Suture the skin with 00000 Dermalon or fine silk. Place a suture so as slightly to evert the lid margin.

8 Incise and remove a proper triangle of skin (base on the canthotomy incision) to allow adjustment of the two lids

9 Dress with a moist eye pad and fluff gauze

The author presents a surgical management which meets all requirements of the average case both functional and cosmetic. It is accurate in its planning and is readily accomplished

It was suggested by a simple, accurate and satisfactory correction of lid notches and distortion following vertical and diagonal lacerations with tissue loss These are readily corrected by a proper Z plastic utilizing the entire lid thickness for the flaps (see p 663)

The procedure is comparable to the cleft lip technic which Hagedorn described in 1884 (see p 663) to eliminate the notching consequent upon linear approximation This was based upon the lid procedure described by Denonvillier in 1859

Procedure.

1 Mark with a needle and methylene blue a point *B* above the defect that is equidistant from the hair-bearing lid margins (*A* and *C* in Fig. 269)

2 Bisect this line on both the medial and lateral edges of the defect Mark as above (*D* and *G*)

3 Mark a point in the median lid skin directly (horizontally) mesial to this bisection point which is parallel to and equidistant above the lid margin (*F*) This outlines a square section.

4 Determine a point on the lateral lid skin (*G*) which is equidistant from the original point *A* and the superior point *B* Mark this point.

5 Pare the margins of the defect from the superior point *B* to the points *A* and *C* Make horizontal incisions 1 mm. long from both points *A* and *C* to permit slight eversion of the lid margins

6 Make moderate traction with a sharp hook in the medial lid margin and incise the full thickness of the lid from *E* to *D* This leaves a small triangular bit of lid which may be useful in the reconstruction (closure) but may be excised if essential

7 Make similar traction and incision on the lateral side from *F* to *A* There remains again a small triangular bit of tissue which is managed as before

8 Perform external canthotomy Thoroughly free the raphe and bordering skin laterally and superiorly

9 Incise the mesial arm of a skin triangle base on the canthotomy incision and apex down, and elevate this skin laterally

10 Pass a 00000 plain catgut stitch through the tarsus to approximate the midpoint of the flap *EDC* to *FA* one to approximate the mid

point of *ED* to *GF* and two sutures to approximate the line *BE* to the line *BG*

11 Approximate the skin with fine silk or 00000 Dermalon and the conjunctiva with fine silk. The latter is not essential. Pass a stitch to evert the lid margin.

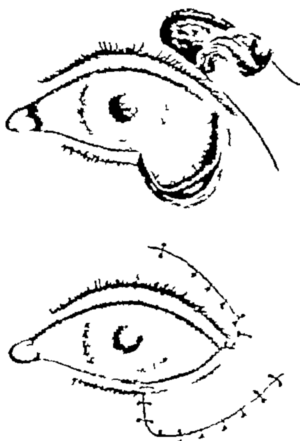


Fig. 270 Partial loss of outer third of lid, correction with a grafted, interpolated flap. *Above* Flap partially dissected and grafted with buccal mucous membrane. *Below* Flap transposed: repair completed.

12. Adjust the lateral palpebral relation and excise the excess skin from the triangle. Close the canthotomy wound with 00000 Dermalon. Dress with a moist eyepad and fluffed gauze with little pressure

Acquired Lesions

These losses may result from either trauma or pathology and its indicated management. There are no fixed reconstructive procedures to restore the variety of losses in various locations, but the basic principles involved apply in any effort of the surgeon to accomplish the best functional and cosmetic result with the least added cosmetic disability

Partial Loss at Either Canthus

In the condition under consideration here the loss is of skin, tarsus and conjunctiva

Requirements. Skin and conjunctiva and lashes

Procedure. *Stage 1* Outline and dissect a skin flap of the required size from the upper lid, with its base lateral to the canthus. Obtain conjunctiva the exact size of the defect, from another lid (depending on the size) or material from the buccal mucosa. Suture this to the raw surface of the distal end of the flap (Fig 270, *above*) and to its su-

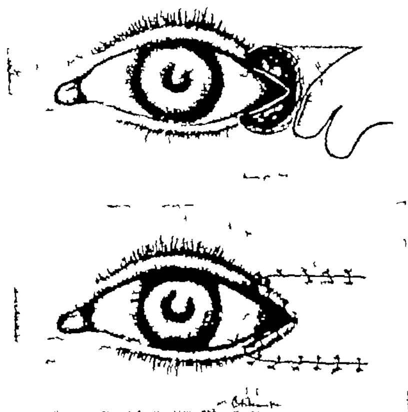


Fig. 271 Loss of skin about outer canthus. Simple rotated flap.

perior raw edge. Suture the margins of the flap with a few interrupted horsehair sutures Delay for growth of graft and blood supply Apply a cotton eye pad and firm gauze dressing for twelve days

Stage 2 An interval of fifteen days passes between Stages 1 and 2

Split the conjunctiva from the skin and the margins of the defect (Fig. 270) Elevate and rotate the flap Suture the conjunctival or mucosal tissue on the flap to the borders of the conjunctival defect with interrupted silk sutures Approximate all skin borders with interrupted horsehair sutures Remove the skin sutures in two days and support with gauze strips applied with collodion

Another Treatment for Partial Loss at the Canthi. The type of flap represented in Figure 271 is an example of several flaps for this purpose which can be based on either the malar or the glabellar region, as the case requires It is a simple, shaped, rotation flap comprised of skin and superficial fat.

Hughes describes another simple method of repairing the defect resulting from excision of a malignancy

1 The conjunctiva is sutured to the skin borders of the defect.

2 A surgical adhesion is created between the residual and the normal lid. This partially protects the cornea.

3 A skin flap of required size is outlined on the upper lid and its superior border incised The skin is elevated by blunt dissection Buccal mucosa of a size to replace the conjunctival defect is grafted on its under surface and superior edge



Fig. 272. Laceration of the lacrimal canal (See text for a detailed discussion of this technic.)

4 The skin flap with its mucous membrane graft is excised after three weeks and transferred to the defect. The borders of the mucosa are stitched to the edges of the conjunctiva and the skin is approximated with fine silk

5 Gauze with petrolatum and a fluffed gauze dressing with moderate pressure are maintained for two weeks The lid adhesion is severed after six to eight weeks.

Repair of the Lacrimal Canal

A lacerated—sectioned—lacrimal canal may be repaired over a silver probe passed through the punctum, then through the proximal end of the canal into the sac and after bending, down the nasal duct. This is retained in position for six to ten days.

An equally simple procedure more comfortable for the patient, permits retention of the obturator in the canal for a longer part of the healing time and even through the period of early scar contraction, if this is desired This usually prevents *occluding* stricture in this and canals like the parotid duct.

Procedure. This is accomplished with a curved atraumatic needle which has been rounded on its point and carries a 00 Dermalon or silk worm gut suture (Fig. 272)

1 Pass the end of the needle through the punctum and the distal fragment of the duct. Use it as a probe to locate the proximal fixed part of the canal

2 Pass it on into the sac, through its superior lateral wall and through the skin

3 Pass the needle through the wall of a piece of soft, small rubber tubing.



Fig. 273 *Above* Carcinoma of upper lid *middle* condition of lid eyes open after reconstruction *below* condition of lid eyes closed, after reconstruction.

4 Approximate the conjunctiva with fine silk, the orbicularis with 000000 plain catgut and the skin with fine silk or Dermalon. The suture lines should be offset or staggered—not superimposed

5 Tie the Dermalon suture running through the canal loosely over the rubber tubing. It should be sufficiently tight to prevent shifting but should not make any traction on the punctum

This obturator may remain in position for several weeks if desired.

Partial Loss of Lid

Under consideration here is reconstruction for a large partial loss with tissues from the locality (Fig. 273)

Loss. All elements of half of the lid

gauze. Apply a moderately firm bandage for forty-eight hours. Remove all skin stitches in two days and support with strips of gauze applied with collodion.

Example. Another relevant case, repaired by the Dupuy Detemps method is represented in Figure 275 (see p 409)

Another Treatment for Partial Loss of Lid. The method contemplated here is reconstruction with a prepared flap from the border of the defect (Imrie) This type of flap is one of a variety of ingeniously designed flaps, either single or multiple obtained from the vicinity of the defect. Lining tissue is provided by grafting conjunctiva or buccal mucosa wherever

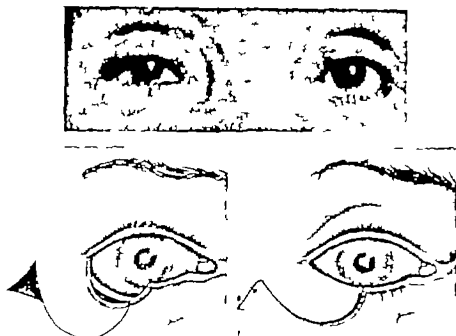


Fig. 276 Reconstruction by the Imrie method for partial loss of the lower lid. *Top* result of the reconstruction, *lower left* skip flap grafted with mucous membrane to replace conjunctival loss, *lower right* flap slid and sutured in position.

this is required (Figs 276 277) These flaps have the *disadvantage* of adding visible scar to the existing cosmetic defect. This disadvantage must, in some instances, be weighed against the patient's status, his economic situation and similar considerations. It is much superior to any introduction of tissue from a distance.

Procedure A flap of desired size and shape is outlined and elevated. If lining tissue is required, this is applied as pictured in Figure 277 c. The graft is not only fixed with sutures to the raw surface of the flap in a proper location, but is continued over the superior raw edge of the flap The flap is replaced in its bed and dressed with proper pressure for seven to twelve days. The time of this dressing is determined by the type

of graft. The pressure on the thick, split graft can be released five to eight days after its application, whereas the pressure on the full thickness graft should remain for a period of twelve days (p 25)

The flap is raised at a second stage after the twelve days the tissue bordering its base and inferior margin is freely undercut and the flap



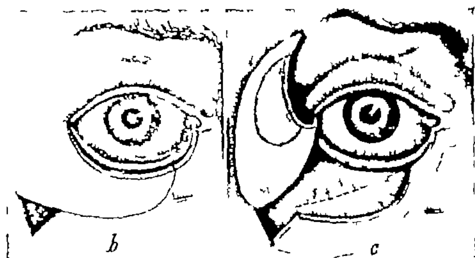


Fig. 277 Large loss of the lower lid. *a*, Condition of lid before and after reconstruction *c* mucous-membrane graft on a dissected skin flap *b* flap slid and fixed in position (Imrie)

slid into place The defect resulting from movement of the flap is closed with interrupted sutures after sliding and adjustment of the bordering tissues.

Another Treatment for Lid Tumor This management is permissible because the scalp tissue utilized does not participate in the lid covering.

Case 1 This was a basal cell carcinoma of long duration. There were no demonstrable metastases. The problem was a simple one of wide excision and acceptable reconstruction.

The residual lid skin, after wide excision, permitted elevation and advancement to cover the lid completely (Fig. 278)

PROCEDURE.

1 A scalp incision was made from a point *A* in the midfrontal line 3 mm. above the border of the tumor around the entire lesion and continued laterally to the midpoint of the brow (*B*)

2. An incision was made through the skin beneath the brow from the margin of the circular incision to the midhorizontal line of the lid at the beginning of its lateral third (*CD*) This outlined two lid flaps. The lid skin below this incision and the skin and brow above it were elevated freely

3 A curved incision (*AE*) was made upward and laterally in the frontal scalp.



Fig. 278 Another method for excision of lid tumor The patient presents a basal cell carcinoma of long duration with no demonstrable metastasis. It requires wide excision and acceptable reconstruction. *a*, The original condition and the outline of incisions for the flaps, *b* a sutured flap following excision *c* the result of this procedure. (See p. 411 for detailed discussion and the procedure.)

4 The scalp was elevated laterally from the frontalis muscle and *so forth* by blunt dissection, and likewise the nasal skin below its incision.

5 A small incision was made in the nasal skin mesial to the canthus to permit elevation of this skin without displacement of the canthus.

6 The flap *BAE* was rotated, and the nasal skin elevated with a sharp hook, and sutured with 00000 Dermalon.

7 The flap was advanced below *CD* and then the flap *BCD* to complete the lid, and sutured with 00000 Dermalon.

8 A dressing was applied with moderate pressure. The sutures were removed on the second or third day and supported with gauze strips applied with collodion (U.S.P.)

Figure 278 *c* presents the condition after six years.

TOTAL LOSS OF LOWER LID

Method I

There are several useful methods of replacing this lost tissue The procedure of Dupuy Dutemps is the method of choice inasmuch as it not only provides all the normal constituents of the lid, but produces the most satisfactory end result from both functional and cosmetic stand points

The procedure described here however shortens materially the time required for repair It can be completed in one major and one minor stage Unless, however the period following completion of the first stage is sufficiently long, the tissue of the region of reconstruction will contract during its late organization, resulting in a less perfect lid than is obtained by the Dupuy Dutemps technic

The loss contemplated here is of the entire lower lid and soft parts in the infra-orbital region beneath the orbital margin

Requirements. Covering skin tarsal support and conjunctival lining.

Procedure. A tunneled flap is used

Stage I Obliterate the infra-orbital defect by freely undercutting the bordering skin and underlying fat and sliding the skin toward the infra orbital margin Fix the skin in this position with several interrupted cat gut sutures (Fig. 285 6 *D*) Pass a stout traction suture through the margin of the tarsus at the middle of the lid and a similar suture on each side near the canthi Place a metal spatula beneath the lid and excise flap *A* (Fig. 279 *e*) of proper size to fill the defect, from the full thickness of the lid. Extend the superior and inferior incisions laterally in the skin to outline a proper pedicle and base for the flap

Undermine the skin and subcutaneous tissue from the border of the defect to the base of flap *B* (Fig. 279 *e*) Draw the pedicle flap through the skin tunnel into the defect. Approximate the conjunctiva around the mesial and inferior borders of the defect with interrupted sutures of fine silk. Approximate the skin with interrupted sutures of horsehair Approximate the borders of the conjunctival defect in the upper lid with interrupted sutures of fine silk and the muscular and cutaneous layer with interrupted sutures of horsehair Pare the margin of the lid at its midpoint and at the junction of its inner and second quarters sufficiently to create a surgical adhesion with a raw margin of the transposed flap Approximate these portions with mattress sutures (Fig. 262 *e* p 393)

Tunnelling of this flap beneath the skin bordering the defect is not essential but it does prevent visible facial scar The skin and subcutaneous tissue may be opened from the midpoint of the lateral border of the defect to the base of the flap the borders of this incision dissected, and the pedicle sutured in its bed.

Dress with a cotton eye pad, fluff gauze and a firm bandage for forty eight hours. Remove the stitches and support the stitch line with gauze strips applied with collodion.

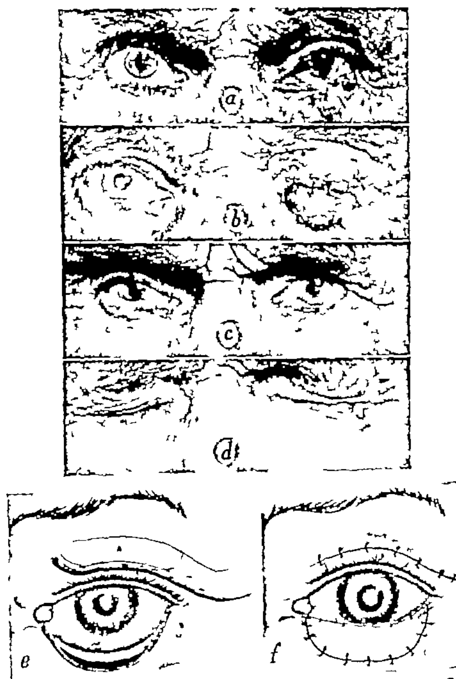


Fig. 279 Total loss of lower lid. Reconstruction with a tunneled flap. *a*, C
noma of lower lid, *b* full thickness flaps removed from upper lid and tunneled
neath the skin bordering the defect, which remained after advancement of the in
orbital soft parts *c* six months later condition of lid, eyes open *d* condition of
eyes closed, *e* *A* full thickness flap excised from upper part of upper lid *B*
of skin tunneled between base of flap and margin of defect *f* completed re
sutures in place.

Stage 2 An interval of two weeks is allowed to elapse between Stages 1 and 2.

Amputate the pedicle at the lateral border of the defect Adjust the bordering edges of the flap and the defect. Close the muscular and skin layers with interrupted sutures of horsehair Withdraw the pedicle from the tunnel adjust its base, and close with interrupted horsehair stitches Permit the surgical adhesions between the lids to remain.

Stage 3 After an interval sufficient for healing and organization of the upper lid the adhesions are cut with scissors and the margin of the lid is permitted to heal

Figure 279 depicts part of the procedure and the end result in a repair such as has been described. Note in Figure 279 *c* that the level of the lower lid has been depressed as a result of organization and scar contraction. The result is good functionally, but not cosmetically

Method II

In the procedure considered here the lid is replaced by a hinged flap from its border It is not a procedure of choice, but, occasionally one of necessity resulting from injury and loss of the upper lid and bordering tissues. It is preferable to use a pedicled flap from the region of the forehead but is no more desirable than a tunneled flap from the forehead, supplied by the anterior temporal artery (Fig. 284 p 423) This loss is too great for an upper lid repair

Requirements. Covering skin, conjunctival lining and supporting tissue

Procedure. *Stage 1* Make a pattern of a hinged flap with its base line *CD* (Fig. 280) along the borders of the conjunctival stump The dimensions of the flap should be such that when the flap is turned upward ("hinged") there will be a straight lid margin between the two canthi (Fig. 280 *A* in *f*) This is an overcorrection and is a necessary allowance for subsequent contraction. Apply the pattern and incise the skin along its mesial and lateral borders. Scratch the line of its inferior border Undermine flap *A* through lateral incisions and shave off its epithelial surface in the manner of cutting a thick, intermediate graft (Fig. 280 *A* in *e*) Cover this raw surface with a flap of buccal mucous membrane of exact size Fix the borders of this flap with a few interrupted horsehair sutures

Apply a thin layer of gauze permeated with Furacin ointment. Instill boric acid ointment in the eye cover with a cotton eye pad and fluff gauze, and apply a firm bandage This dressing should remain in place twelve days, unless there is local pain or abnormal drainage

Stage 2 An interval of fifteen days is allowed to elapse between Stages 1 and 2

Incise the borders of the flap and dissect and fold it upward Close the approximating edges of the flap with several interrupted sutures of fine silk (Fig. 280 *f* *A*) Obtain a full thickness skin graft, having the exact size of the defect, from the back of the ear and approximate it to the skin borders of the defect with interrupted sutures of horsehair Ap-

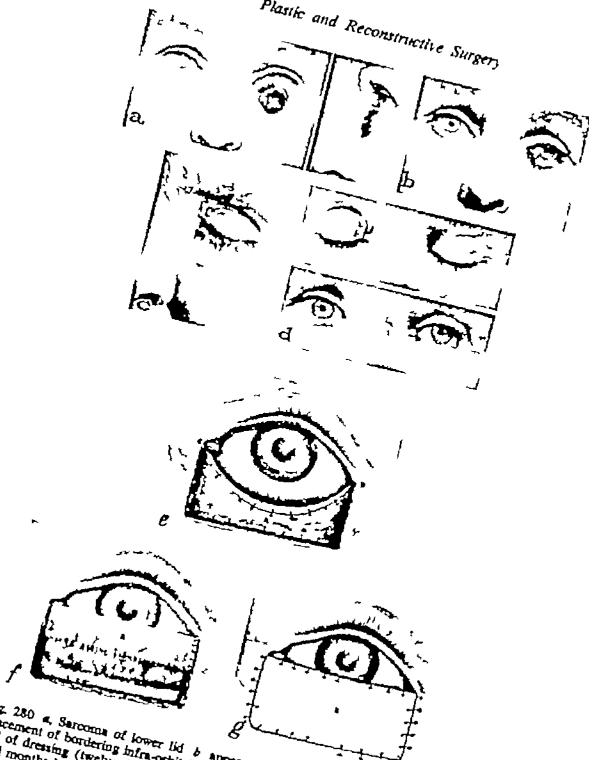


Fig. 280 *a*, Sarcoma of lower lid *b* appearance of patient after excision a advancement of bordering infra-orbital skin, *c* appearance of the graft on first r moval of dressing (twelve days) *d* appearance of reconstructed lid (eye closed several months later *e* *A* mucous-membrane graft on an outlined skin flap *CD* margin of conjunctival remnant, *f* *A* grafted flap folded to replace lining and cul de-sac the margins of the flap are approximated with fine silk sutures *g* *B* full thickness skin graft from mesial surface of ear

proximate the mucous membrane of the lining flap to the upper edge of the grafted flap with interrupted sutures of fine silk Dress as in Stage 1 for a period of twelve days. Continue a lighter dressing, consisting of a cotton eye pad and fluff gauze, for several days following this period.

Close the defect on the back of the ear by undermining and sliding its borders. If this is not possible, the defect is repaired with a thick split skin graft taken from some other surface of the body

The graft on the lid may be a thick intermediate cut taken from some other surface of the body, rather than a full thickness flap from



Fig. 281 Total loss of lower lid and bordering infra-orbital tissues. Interpolated scalp and forehead flap containing the temporal artery

the back of the ear but the texture and color of the flap from the ear are more satisfactory than those of other skin

The result of such a procedure is pictured in Figure 280

Method III

In the method described here, replacement is by a prepared pedicle, forehead flap This *procedure is not a method of choice* but, occasionally one of necessity Such flaps for the repair of lids, face and nose should be avoided when less mutilating procedures can be used (Fig 281)

Requirements. Covering skin supporting tissue and conjunctival lining.

Procedure. *Stage 1* Outline a narrow flap of scalp including the anterior temporal artery and its branches in the hair-bearing area, so that its distal end is placed on a hairless part of the forehead. Incise the lateral and distal borders of the hairless part of this flap in a pattern which will replace the defect in the lid Elevate this flap Graft its raw

superior border and base surface with buccal mucous membrane of a size and shape to replace the conjunctival defect. Replace the flap in its bed, approximate its borders with a few interrupted horsehair sutures, and apply a firm gauze dressing for twelve days

Stage 2 An interval of fifteen days passes between Stages 1 and 2

Incise the borders of the pedicle and flap Free the flap Make an incision from the base of the anterior edge of the flap through the skin and subcutaneous tissue of the face to the borders of the defect. Dissect the borders of this incision and rotate the pedicle of the flap into this base With interrupted sutures of fine silk, suture the borders of the mucous membrane on the flap to the borders of the conjunctival defect. Approximate all skin borders with interrupted sutures of horsehair Apply a cotton eye pad, fluff gauze and a firm bandage

Undermine the scalp bordering the defect left by elevation of the pedicle Approximate these borders as far as possible by sliding and with a few small tension sutures of silkworm gut. Cover the defect with several thicknesses of gauze permeated with scarlet red ointment, fluff gauze and a bandage Remove the skin sutures from the lid at the end of two days and support with strips of gauze applied with collodion.

Stage 3 The interval between Stages 2 and 3 is three weeks.

Amputate the pedicle dissect it from its bed, and return it to the scalp Undermine the skin borders of the facial defect and approximate all skin edges with interrupted sutures of horsehair Remove the sutures on the second day and support with strips of gauze and collodion

Method IV

The simple procedure described here requires only skin covering. The area is too large for use of skin from the normal right lid. The character of the temporal skin is such that it will blend well with the lid It is thin A free graft from the mesial surface of the ear is not justified under the circumstances (Fig 282, *a b* p 419)

Requirement. Skin covering only

Procedure. *Stage 1*

1 Incise the conjunctiva along its junction with the pigmented lid margin. Continue the incision from its medial end upward and outward above the border of the pigment to terminate 2 or 3 mm beyond its lateral border

2 Outline a temporal flap with its mesial border perpendicular to the termination of the superior incision around the lesion and its termination at the outer canthus Its lateral border terminates on the level of the end of the above incision

3 Incise these two borders

4 Dissect the nevus from the underlying muscle and fascia.

5 Elevate the flap and bordering skin. Approximate and suture this skin with 00000 Dermalon

6 Rotate the flap into the lid defect. Suture to the conjunctiva with fine silk and to the skin with 00000 Dermalon

7 Instil boric acid ointment. Dress with moderate pressure (Fig. 282 *c d*)

An interval of six weeks elapses

Stage 2 Lower Lid The patient desired to keep the lashes on the lower lid regardless of the pigment and was not interested in the grafting of new cilia



Fig. 282. Method IV Benign melanoma involving both lids. *a* and *b* The original condition. c and *d* The condition after rotation and interpolation of a temporal flap the result of excision and advancement of the mesial skin of the lower lid. *f* The finished result of the procedure. (See p. 418 for detailed description and procedure.)

1 Incise the skin just below the cilia bearing area from the punctum to the external canthus Make a second incision from this point down ward and upward to the orbital margin below the beginning of the first incision This provides a sufficient base for this tongue-shaped flap (Fig. 282, *e*)

2 Excise the pigmented skin.

3 Elevate the remainder of the flap and the bordering skin below the canthus.

4 Advance and suture the flap with 00000 Dermalon.

5 Instil boric acid ointment and dress with moderate pressure (Fig. 282, *e f*)

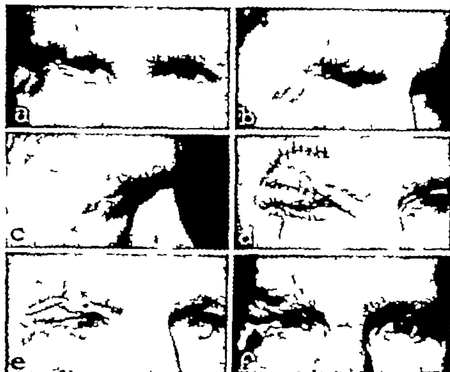


Fig. 283 Method V This patient suffered a traumatic surface loss, muscular cutaneous, of the lateral third of the upper lid, loss of a vertical full thickness strip of the lid at the junction of the outer and middle thirds, with subsequent scar contraction fixing the residual lid to the orbital margin entropion with lash irritation of the globe traumatic tattoo about the external canthus and supra-orbital areas. *a*, *b* and *c* The original healed condition. *d* The condition after healing and organization of a full thickness Z plastic on the upper lid, and a recent rotated interpolated frontal flap *e* The healed condition of the stage in *d* and considerable excision of pigmented skin about the outer canthus. (See text for a detailed discussion and the procedure.)

Method V

This method and the one preceding are introduced into the discussion of large or total losses of the lower lid because the principles involved are identical regardless of which lid is involved They are both desirable examples of the procedures discussed.

Case I. There are four results of a trauma demanding correction. The patient was dragged over a cinder-paved road for some distance three months before these observations (1) surface loss, musculocutaneous, of the lateral third of the upper lid, (2) loss of a vertical, full thickness strip of the lid at the junction of the outer and middle thirds with subsequent scar contraction fixing the residual lid to the orbital margin, (3) entropion with lash irritation of the globe, and (4) traumatic tattoo about the external canthus and supra-orbital areas (Fig. 283 *a*, *b*, *c*)

The length of the left palpebral fissure was 1¼ inches (3.5 cm.) There was ⅞ inch (2.3 cm.) of the lower lid and ½ inch (1.3 cm.) of the upper lid intact on the right nasal side. The outer third of both lids was closed by scar

An area of eyebrow ⅜ inch (1 cm.) long, beginning ½ inch (1 3 cm.) from the nasal end of the brow was replaced by frontal skin drawn down and sutured to the incised lid.

There was slight levator action in the lid.

Procedure STAGE 1 RELEASE OF ADHESION OF THE OUTER LIDS AND REMOVAL OF SCAR, SKIN GRAFT

1 The scar was dissected from the outer third of the covering surface and margins of the lids and lateral to the canthus. The dirt and fine cinders were removed from the upper lid.

2. Full thickness skin of proper size was removed from the back of the left ear The bordering skin was undermined and this defect closed.

3 The skin was applied to the lid defect and dressed as previously directed (see p. 25)

An interval of eight weeks elapsed.

STAGE 2. Z PLASTIC TO LENGTHEN THE LID VERTICALLY AND CORRECT A MARGINAL NOTCH. This procedure is useful and important here inasmuch as it simply and effectively replaces two and, frequently three procedures to correct defects and contractures of the several lid structures.

The shifting and repositioning of parts of the levator tendon and the palpebral ligament not only does not restrict the muscular action, but improves it in such cases.

1 A Z was designed with its central arm running from a point just above the hair-bearing lid margin to the top of the scar at the orbital roof. This was ⅜ inch (1 cm.) An upper arm of similar length was placed on the lateral side and a lower one mesially (see Z Plastic, p 221)

2 A spatula was placed posterior to the lid, which was incised its full thickness through the lines of the Z.

3 The scar about the base of the upper flap was freed. The triangular flaps were transposed and the edges approximated with a few fine silk sutures passed from the skin through the conjunctiva on one side, from the conjunctiva to the skin on the opposite side, and then through the skin margins to be tied at the point of beginning—a vertical mattress suture which should be tied loosely

(This may be planned to lengthen the lid ⅜ inch (1 cm.) to ½ inch (1.3 cm.)

4 Boric acid ointment was instilled and a dressing with an eye pad and fluffed gauze was applied with moderate pressure.

An interval of nine weeks elapsed.

STAGE 3 INTERPOLATED FLAP' SCAR REMOVAL (Fig. 283 *d*) Contraction of the deep scar around the canthus and adjacent lid was not controlled by the original graft. It had to be removed, the deep scar with foreign material further excised and the defect re-covered.

1 The grafted skin on the lid and so forth was excised.

2. A lateral canthotomy incision was made.

3 The pigmented bordering skin was elevated freely All underlying scar about the canthus and on the lid was excised as was all pigmented bordering skin permitting closure.

4 A temporal frontal flap was rotated (Fig. 283 *d*) as in Method IV (Fig. 282)

5 Suture was made with 00000 Dermalon and fine silk.

An interval of twelve weeks elapsed.

STAGE 4 DUPUY-DUTEMPS PROCEDURE. Gradual scar contraction in the tarsal and conjunctival layers of the lateral third of the lid gradually resulted in return of the entropion and lash irritation. An increase in these layers is essential. This was accomplished with Dupuy Dutemps procedure (see Method VII, Fig. 285 p 425)

An interval of six months elapsed.

STAGE 5 OPENING OF THE LIDS AND READJUSTMENT OF THE SKIN COVERING (*see* Fig. 285) The end result of this management is seen in Figure 283 *e* There is some skin fullness to be excised as outlined in this figure.

There remains still some pigmented skin which could be removed finally by further multiple excisions. This is not the present choice of procedure, however The technic described recently by Iverson is the best correction of this condition (see Traumatic Tattoo p. 243)

Method VI

In the method now to be considered replacement is with a prepared forehead flap as a tunneled pedicle supplied by the temporal vessels. This procedure is preferable to the preceding one in which a pedicled flap from the scalp is used It eliminates entirely one procedure and produces much less cosmetic disability

Requirements. Skin covering, conjunctival lining and supporting tissue

Procedure. *Stage 1* Make an accurate pattern of the defect. Outline this pattern on the forehead, at the distal end of the anterior branch of the temporal artery (Fig. 284 *A*) The location of this flap is determined by the length of the pedicle which will permit its transference to the defect. Incise the superior inferior and mesial borders of this flap Undermine Graft the raw surface and superior edge of the flap with buccal mucous membrane of the exact required pattern Approximate the edges of the flap with a few interrupted sutures of horsehair Apply a firm fluff gauze dressing for a period of twelve days

Stage 2 Outline the course of the anterior branch of the temporal artery leading to the lateral margin of the forehead flap (Fig. 284 *top B*) Carry an incision through the scalp but *not into the underlying subcutaneous tissue* from the end of the flap to a point bordering the helix of the ear (Fig. 284 *top B*) Separate the scalp bordering this incision Incise along the borders of the temporal vessels to the periosteum in a manner that will include these vessels in a pedicle of tissue about ¼ inch (0 6 cm.) in width (Fig. 284 *middle D*) Incise and free the flap and the vascular pedicle already outlined, down to the helix of the ear (Fig. 284 *middle C A*) Undermine the skin and subcutaneous tissue from this incision in front of the ear to the lateral margin of the defect in the lid.

Pull the prepared flap and its vascular pedicle through the tunnel beneath the skin and approximate it to the defect. Take care that the vascular pedicle is not kinked at the point of turning into this tunnel. If this occurs the skin should be opened along the artery in front of the ear to provide a greater arc for its rotation Approximate the mucous membrane of the flap to the conjunctival borders of the defect with interrupted sutures of fine silk Approximate the skin with interrupted sutures of horsehair Close the scalp defect with interrupted horsehair sutures.

Instil boric acid ointment into the eye apply a cotton eye pad, fluff gauze and moderately firm dressing. Continue use of the dressing for forty-eight hours Remove the skin stitches and support with gauze strips applied with collodion Remove the silk stitches from the conjunctiva on the eighth day or shortly thereafter



Fig. 284 Total loss of lower lid use of forehead flap and tunneled pedicle containing temporal artery *Top* Outline of flap, *A* on distal end of the artery the raw surface of this flap is grafted with mucous membrane. *Middle* Incision, *B* in scalp *C* anterior temporal artery and vein enclosed in subcutaneous tissue, *D* (inset) cross section of pedicle, *C A* grafted scalp flap the forceps are inserted beneath the tunneled skin to grasp the flap, *A* and draw it into the defect. *Bottom* Completed repair

Method VII

According to this method, the lost tissues are replaced with normal structures from the opposing lid (Dupuy Dutemps) This is the *procedure of choice*

Requirements. Skin, musculotarsal layer and conjunctival lining.

Procedure. *Stage 1* Make an incision in the conjunctiva 1 mm. from the margin of the lid, extending from one canthus to the other This incision should be designed to avoid injury to the hair follicles of the eye lashes (Fig. 285 *6 A*) Free the skin from the underlying musculotarsal layer with small, curved, blunt-nosed scissors (Fig. 285 *6 B*)

If infra-orbital soft tissue has been lost, the defect is obliterated by undercutting the borders of the defect, elevating this tissue, and fixing it to the infra-orbital margin with several interrupted sutures of catgut (Fig. 285 *D*)

Suture the conjunctival stump *C* to the free edge of the flap *B* of the upper lid, using interrupted stitches of fine silk (Fig. 285 *7 BC*) Tie these sutures *tightly* and leave their ends long enough to project on the face (Fig. 285 *2 7*) Approximate the edge of the line of incision on the posterior surface of the lid *A* and the raw edge of the skin bordering the defect, using interrupted horsehair sutures (Fig. 285 *2*)

Apply a cotton eye pad, fluff gauze and a moderately firm bandage. Remove the skin stitches on the second day and apply two or three strips of gauze with collodion across the line of suture. The silk stitches in the conjunctiva will cut out by the fifth or sixth day and this will permit removal by traction

Stage 2 An interval of three to four weeks is allowed to elapse between Stages 1 and 2 This is the minimal time required for establishment of adequate blood supply across the line of approximation of the conjunctiva A longer interval is desirable when circumstances will permit.

Incise the scar along the line of union of the upper lid and the cutaneous margin of the defect. Dissect the skin from the underlying soft tissues with small, blunt, curved scissors Elevate the lid and lash margin to its normal level (Fig. 285 *8*) Outline incise and elevate a pedicled flap from the skin of the upper lid, of a length and width sufficient to fill the skin defect in the lower lid. Rotate this flap and stitch it to the borders of the defect with interrupted sutures of fine horsehair (Fig. 285 *3*) Close the defect in the skin of the upper lid with interrupted sutures of fine horsehair (Fig 285 *3*) Approximate the upper lid and the upper margin of the transposed flap with interrupted sutures of fine horsehair (Fig 285 *3*) Apply a cotton eye pad, fluff gauze, and moderately firm dressing. Remove all skin stitches on the second day and support with cotton gauze applied with collodion.

Stage 3 The interval between Stages 2 and 3 is three weeks.

Insert one blade of a blunt nosed scissors beneath the conjunctiva at

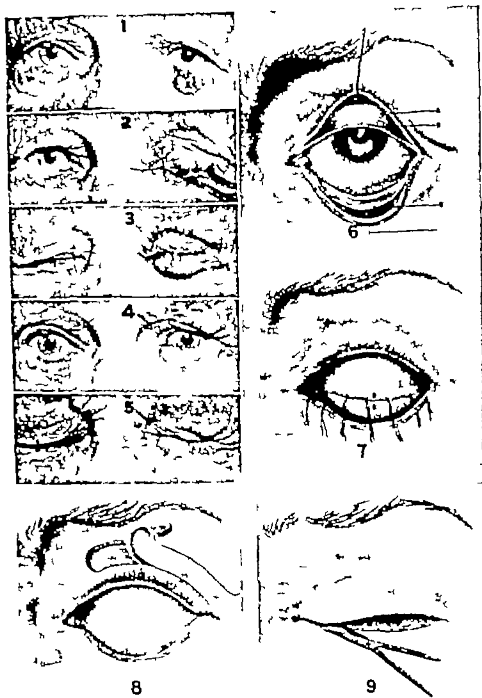


Fig. 285 Total loss of lower lid, Dupuy Dutemps procedure. *1* Carcinoma of lower lid. *6* The defect resulting from excision of lower lid and bordering soft parts is partially obliterated by advancement of the surrounding infra-orbital skin, which is fixed with catgut sutures to the orbital margin, *D* *A* separated skin of upper lid *B* "musculotarsoconjunctival" layer *C* conjunctival stump. *2* Suture of skin margin of upper lid to skin margin of lower defect. *7* Approximation of *B* and *C* with fine, tightly tied horsehair sutures. *3* and *8* Skin flap *E* from upper lid to replace skin defect in lower lid. *9* Separation of the two lids with scissors along line between the two canthi. *4* Condition of lid, eye open, after reconstruction. *5* Condition of the lid eye closed, after reconstruction.

the outer canthus Incise the full thickness of the lid, along the margin of the upper lid to the caruncle at the inner canthus (Fig. 285 9) Control the oozing on the margin of the lid with sponge pressure. Instill boric acid ointment into the eye. Cover with a cotton eye pad, fluff gauze and bandage with a moderate pressure. Continue such dressings for twenty four hours. Permit the raw margin of the lower lid to epithelize. The results of such a procedure are depicted in Figure 285

Lashes can be grafted on the lower lid if this seems desirable

EYELASHES

The absence of a part or all of the lashes on a lid margin is an evident and frequently annoying cosmetic disability Several methods of restoration are practiced. The most recent technic described by Schussler and Filmer has the most to recommend it in the average case.

Those cases which follow burns with marked scar contraction and ectropion may use this procedure, but are well repaired by the use of an inverted, full thickness skin graft which includes a margin (3 mm.) of the eyebrow and which is taken from the opposite lid. Such grafts taken from the superior margin of the brow are not so desirable because the thicker scalp skin does not blend with the bordering lid skin

Grafts taken from the scalp posterior to the mastoid and those from the borders of the midoccipital scalp are useful, but lack some of the advantages of the procedure to be described. They are however a necessity in cases of destruction of the brow (trauma, burns, malignancies, and so forth)

The cilia are thicker on the nasal side of the brow There are more hairs in a narrow width. They are, as a rule, neither spaced nor directed as are the normal lash hairs. Many people do not have upward and outward directed hair on the nasal side of the brow The hair is directed temporally along the entire length of the brow

The graft is cut vertically and several are taken if the width of the brow is narrower than the lid defect.

Procedure.

1 Make parallel vertical incisions 3 mm. apart through the full thickness of the skin. These should include three or four rows of cilia and a thin layer of subcutaneous fat.

2. Incise the lid margin to the desired depth.

3 Lift the incised graft with small sharp hooks and plant it in the prepared bed. Be certain that the cilia are in the same direction as the normal ones on the lid.

4 Suture with fine silk. Leave alternate sutures long and use them to retain a pressure dressing.

5 Close the defect in the brow

6 Remove the dressing in ten or twelve days.

All the cilia may fall out. The marginal ones do not regenerate The central row or rows grow again in a few weeks.

TUMORS

Neoplasms, both malignant and benign are managed in this area as elsewhere It is not the purpose of this discussion to deal with the various requirements of proper removal, but, rather, the restorations necessitated by such essential procedures.

Several of both types of tumors are presented in the preceding cases

SUNKEN EYEBALL. TROPHIC ABSORPTION OF ORBITAL SOFT PARTS

This disabling and unsightly deformity frequently follows trauma to and about the orbit. Its results are depicted in Figure 286 Repair with a subcutaneous graft (dermal) is considered here

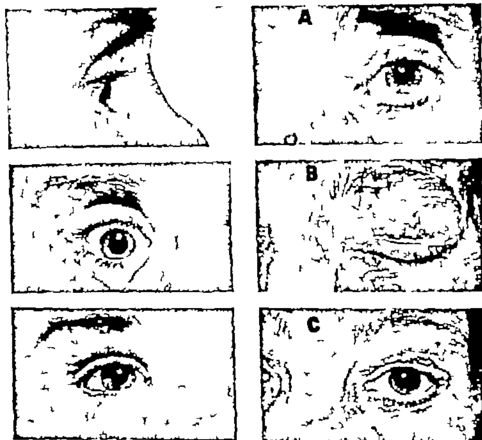


Fig. 286 Trophic absorption. *Left column*, Appearance of sunken lids before (*top* and *middle*) and after (*bottom*) correction *right column A* sunken upper eyelid before correction *B* point of insertion of dermal graft, simple suture *C* appearance of lid ninety days after insertion of graft.

Requirements. Tissue beneath the skin and subcutaneous tissues of the lid, supported by the orbital septum

Procedure. Make an incision ¼ or ⅜ inch (about 0 6 or 1 cm) in length through the skin at the lower margin of the eyebrow (Fig. 286 *B*) Separate the skin and subcutaneous tissue of the lid with small, curved, blunt-nosed scissors. Carry this dissection well beneath the bony margin

1

2

3

A

B

C

4

of the orbit. Dissect a strip of skin of sufficient width and length to provide a double layer (p 135) Prepare the graft as directed on page 177 Pass a dermal suture, armed with a straight cutting needle on each end, through each of the distal corners of the graft. Pass these needles through the incision and beneath the tunneled skin to emerge at the lateral border of the defect (Fig 93) Draw the graft into the tunnel and remove the traction sutures. Close the skin incision with interrupted horsehair sutures

Apply a firm fluff gauze dressing for several days. This dressing should remain until danger of collection of fluid has passed and adhesion between the graft and soft parts has occurred. The defect should be overcorrected. An allowance of 10 to 20 per cent for shrinkage during organization of the graft should be made The procedure can be repeated after proper intervals, as often as necessary to obtain the desired result

EPITHELIAL LINING OF ORBITAL CUL-DE-SAC

The purpose is to produce a lined sac or pocket for a prosthetic eye which will retain the prosthetic eye in a stable manner without weight or pressure on the lower lid (Fig. 287)

Procedure. External canthotomy is performed The sac formed is larger than the normal palpebral slit. Introduction of the skin-covered mold requires this opening (Fig. 287 *4 C*) The dissection begins slightly above and below the margins of the respective lids and is carried along the plane of the normal conjunctiva. The tarsus serves as a guide in places where the conjunctiva has been destroyed. The *tarsus and the attachment of the levator muscle must be preserved* The dissection of the upper lid is carried superiorly and posteriorly, but does *not extend* to the periosteum of the roof space is left for the levator muscle (Fig 287 *4 A*) It is carried to the periosteum on the temporal side inferiorly along the floor and mesially behind the caruncle and along the anterior crest of the lacrimal fossa (Fig 287, *5 D*) Remove granulations and scar tissue and obliterate any tracts or pockets.

Mold sterile (autoclave) dental modeling compound into the formed pocket. This is so shaped as not to distort the lids (Fig. 287, *6 H*) Cover the mold with split skin which *contains no corium* Arrange the skin raw surface external so that its approximating edges correspond to the margins of the lids (Fig. 287 *6 G*) Insert the skin-covered mold. Approximate the margins of the lids and retain them in approximation with several strips of fine-meshed gauze applied with collodion vertically across the lids.

Fig. 287 Epithelial lining of the orbital cul-de-sac, *1* Original condition, *2* completion of cul-de-sac· *3* prosthetic eye in cul-de-sac; *4 A* location of levator muscle *B* limit of dissection of soft parts C canthoplasty· *5 D* line of desired adhesion between periosteum and implanted cutaneous lining of sac· *6 E*, levator muscle *F* tarsus· *G* skin graft, *H* mold supporting skin graft and producing the desired form of the constructed cul-de-sac; *I* contact between skin graft and periosteum of orbital floor

Apply strips of oiled silk or rubber treated with boric acid ointment to each lid, so that the margins of the lids remain uncovered. Apply also a cotton eye pad, gauze and strips of adhesive tape for retention. *Finally a bandage is applied with moderately firm pressure.* Remove the dressing in six or seven days Clean and dry the lids *gently Do not attempt to inspect the graft* Apply dressings as above, but with less pressure Dress daily thereafter or as required.

Remove the *mold* in ten or twelve days from the time it was inserted. Dry in air or with an electric light bulb Replace the mold This process is repeated daily until organization has occurred. It is well to oil the graft after two or three days of this daily routine with such oil as is used in the nursery Repair the wound of canthotomy Oil. Place a light dressing of gauze ribbon in the socket. Insert the prosthesis as soon as the line of suture of the canthotomy is well healed.

PARESIS AND PALSY OF THE LIDS

See Meloplasty (p 316) for a discussion of the several methods of management.

ORBITAL RECONSTRUCTION FOR PROLAPSED EYEBALL

In the case under consideration here the prolapse was attributable to loss of the bony floor and displacement of the malar (zygomatic) bone.

The patient pictured in Figure 288 *upper* suffered a compound, comminuted fracture of the malar infra-orbital and nasal regions. The malar fragment was driven downward, backward and inward into the posterior part of the maxillary antrum The mesial part of its orbital attachment was fractured from the body of the bone and was removed Almost all the bony floor of the orbit and all the thin bone of the wall of the canine fossa were removed by the attending surgeon The malar bone remained because of its position in the antrum behind the prolapsed soft orbital content and the eyeball

The situation represented in Figure 288 *upper* graphically demonstrates the *fallacy of removing loose fragments of bone which retain any attachments whatsoever*

Requirement. Reconstruction of the orbital floor to furnish support for the orbital content.

This requirement has been met by suturing a broad strip of fascia lata to the periorbita attached to the mesial and lateral borders of the frontal bone. This forms a tough, inelastic sling or hammock. The use of cartilage introduced immediately above the inferior part of the prolapsed periorbita fails to produce a desirable result The *procedure of choice* is reduction of the fractured and displaced bony elements and restoration of the bony floor The procedure is rarely necessary if the first aid and subsequent immediate care are conservative and intelligent.

Procedure Make an incision 1½ inches (3 8 cm) long about ⅜ inch (about 1 cm.) above the gingival border in the canine fossa. Separate the

or temporary wiring, or firmly enclosed in a fixed cover of soft tissue It is carved in a general wedge shape with its thick margin externally, forced under the residual, elevated periosteum and anchored as above. In some cases, particularly in those in which the correction of the orbital rim is the main purpose, this edge is carved to conform to the remaining bony rim and may or may not retain its perichondrium in the case of autogenous material.

In cases of old bony displacement which do not permit of reduction a thin plate of the orbital rim may be separated with a chisel and raised with the periosteum to receive the cartilage implant. Cancellous bone from the ilium may be used.

There can be no fixed technic for these reconstructions because no two losses are identical and present the same requirements. For example, the loss may be a part of the orbital rim and displacement or loss of part of the floor or it may be the loss of an entire wall such as the zygomatic orbital bone the ethmoidal lamina or the orbital roof (frontal plate) resulting in dural exposure and so on

The case to be discussed presents such extensive loss that these procedures are not available

Case I. The patient was a chemical engineer who was watching an operation inside a gas furnace through a heavy glass peephole in its side. The furnace exploded, and the glass of this peephole produced the orbital injury He suffered a total loss of the orbital content, and much of the orbital framework.

At the time of his arrival, some days after the accident, the entire soft content of the orbit was missing. The lamina papyracea of the ethmoid, much of the lacrimal, the orbital plate of the frontal the entire floor and lower orbital margin and the frontal portion of the upper orbital rim were missing. The dura was exposed through the frontal plate in a defect 1¼ inches (3 cm.) long and ½ inch (1.5 cm.) wide. This dura was adherent to the border of the bone defect and its surface covered with dirty exudate—pachymeningitis. There was slough and necrosis about an optic nerve stump which was about ¼ inch from the dura mater Two pieces of glass were removed from this area. The antrum cavity was filled with debris and purulent exudate. There was a draining fistula in the long, irregular scar in the right cheek (Fig. 290, *a b c* p. 435)

The problems involved were (1) removal of infection from the dura in the orbit, the antrum and the tissue of the face (2) reduction of the fractured zygoma and great wing of the sphenoid (3) protection—covering—of the dura about the optic foramen and in the frontal area (4) retention of sufficient maxilla to support the alveolar process and the teeth (the infra-orbital nerve was gone there was however a good dental blood supply) (5) closure of the opening into the nose (6) closure of the opening into the antrum (7) filling and sealing of the orbit and (8) new eyelids.

The tissue requirements were: (1) skin to close the nasal wall and the anterior orbital opening; (2) thin skin of the color and texture of the face skin for the lid coverings (their posterior surfaces were covered with split skin from the abdomen) (3) fat to cover the orbital granulation tissue and to fill the orbit (4) cartilage to restore the orbital rim and the zygomatic contour and to support the new eyelids.

Procedure STAGE 1 FRACTURE REDUCTION OF THE ZYGOMA AND SPHENOID WING DEBRIDEMENT DRAINAGE, ANTISEPSIS. The antrum was opened through the nasal margin of the maxilla to retain as much of its anterior wall as possible. This wall remained as the principal support for the alveolar process and the teeth of this side. The entire orbital portion of the infra-orbital nerve was lost. There was a residual adequate blood supply with live teeth.

tained for eight days This resulted in sufficient adhesion of the orbital soft parts to permit withdrawal of the packing.

The V-shaped cutaneous scar below the lower lid was opened and dissected to the remaining periorbita and scar beneath the globe. This dissection was carried mesially and laterally to the frontal processes on each side The periorbita in these frontal areas was incised and separated, and the underlying surfaces of bone were freshened with a chisel.

An osteoperiosteal graft (p 38) of proper length and desired width was removed from the flat surface of the left tibia. This was introduced into the dissected pocket beneath the eye with its periosteal surface upward The ends of the graft were slid under the incised periosteum in the two frontal regions so that the bony surfaces of the graft and the freshened areas approximated Packing was again introduced into the antrum to support the graft and maintain the globe in extreme overcorrection The packing was removed after several days. It was subsequently noted that the eyeball had gradually become displaced downward. Roentgenologic study of the region revealed that the pull of scarring had displaced the malar bone and the graft (Fig. 289 *a*, *A B*) The malar bone was further freed of scar attachments and was reduced to its normal position The bone graft was again supported by antral packing for several days. The final position of the malar bone and the graft is evident in Figure 289 *b A B*

Major Loss of Bone and Content

The reconstruction of the orbit per se—the bony framework—may be accomplished with either cartilage or bone depending on the location and extent of the loss This is an acceptable management, particularly in losses of the orbital rim with displacement of adjacent floor lateral or superior wall. It is useful in cases of ptosis of the globe loss of the normal support of the external raphe displacement of the upper lid attachment or support, and the cosmetic results of loss of contour It is not the choice of procedure in displacement of the malar bone with loss of its orbital component together with loss of the maxillary part of the rim and floor and so forth.

Excellent contributions of methods of exact appraisal of the bony loss and the planning and technic of this reconstruction were made during World War II The work of Shiflett, quoted by Spaeth from a personal communication demonstrates the proper positioning of tube and plate to furnish a clear stereoscopic view of the loss and to allow measurements on tracings of the two sides, based on the normal orbit, accurate designing of a model for the required implant, and, finally a record for checking the accomplishment.

Cartilage is nourished by lymph and does not require a direct blood supply per se. It is well planted under periosteum and covered anteriorly with soft tissue having adequate circulation Either autogenous or preserved cartilage may be utilized

The cartilage should be firmly fixed in position by suture with catgut

or temporary wiring, or firmly enclosed in a fixed cover of soft tissue It is carved in a general wedge shape with its thick margin externally, forced under the residual elevated periosteum and anchored as above. In some cases, particularly in those in which the correction of the orbital rim is the main purpose, this edge is carved to conform to the remaining bony rim and may or may not retain its perichondrium in the case of autogenous material

In cases of old bony displacement which do not permit of reduction a thin plate of the orbital rim may be separated with a chisel and raised with the periosteum to receive the cartilage implant Cancellous bone from the ilium may be used

There can be no fixed technic for these reconstructions because no two losses are identical and present the same requirements For example, the loss may be a part of the orbital rim and displacement or loss of part of the floor or it may be the loss of an entire wall such as the zygomatic orbital bone the ethmoidal lamina or the orbital roof (frontal plate) resulting in dural exposure, and so on

The case to be discussed presents such extensive loss that these procedures are not available

Case I. The patient was a chemical engineer who was watching an operation inside a gas furnace through a heavy glass peephole in its side The furnace exploded, and the glass of this peephole produced the orbital injury He suffered a total loss of the orbital content, and much of the orbital framework.

At the time of his arrival, some days after the accident, the entire soft content of the orbit was missing. The lamina papyracea of the ethmoid, much of the lacrimal the orbital plate of the frontal, the entire floor and lower orbital margin and the frontal portion of the upper orbital rim were missing. The dura was exposed through the frontal plate in a defect 1¼ inches (3 cm.) long and ½ inch (1.5 cm.) wide This dura was adherent to the border of the bone defect and its surface covered with dirty exudate—pachymeningitis. There was slough and necrosis about an optic nerve stump which was about ¼ inch from the dura mater Two pieces of glass were removed from this area. The antrum cavity was filled with debris and purulent exudate. There was a draining fistula in the long, irregular scar in the right cheek (Fig. 290 *a b c* p. 435)

The problems involved were (1) removal of infection from the dura, in the orbit, the antrum and the tissue of the face· (2) reduction of the fractured zygoma and great wing of the sphenoid (3) protection—covering—of the dura about the optic foramen and in the frontal area (4) retention of sufficient maxilla to support the alveolar process and the teeth (the infra-orbital nerve was gone· there was, how ever a good dental blood supply) (5) closure of the opening into the nose (6) closure of the opening into the antrum (7) filling and sealing of the orbit, and (8) new eyelids.

The tissue requirements were (1) skin to close the nasal wall and the anterior orbital opening; (2) thin skin of the color and texture of the face skin for the lid coverings (their posterior surfaces were covered with split skin from the abdomen) (3) fat to cover the orbital granulation tissue and to fill the orbit, (4) cartilage to restore the orbital rim and the zygomatic contour and to support the new eyelids.

Procedure· STAGE 1 FRACTURE REDUCTION OF THE ZYGOMA AND SPHENOID WING DEBRIDEMENT· DRAINAGE, ANTISEPSIS. The antrum was opened through the nasal margin of the maxilla to retain as much of its anterior wall as possible. This wall remained as the principal support for the alveolar process and the teeth of this side. The entire orbital portion of the infra-orbital nerve was lost. There was a residual adequate blood supply with live teeth.

An incision was made, beginning in the buccal sulcus along the bony margin of the pyriform fossa, curved outward and downward above the gum tissue, and carried through the periosteum. The mucoperiosteum was elevated over the canine fossa and along the lateral wall of the nose beneath the attachment of the inferior turbinate. The bone was removed along the pyriform margin and laterally in the canine fossa with biting forceps, and continued upward along the pyriform edge to the top of the antrum cavity. The nasal bone plate was removed up to the attachment of the inferior turbinate bone and posteriorly for ½ inch (1 cm.) just sufficient to allow the desired procedure in the cavity.

The fractured zygomatic fragments were moved into normal position.

The antrum cavity was débrided, and several pieces of glass were removed posteriorly.

A tongue-shaped flap was incised in the elevated nasal mucoperiosteum and reflected laterally over the cut bone surface at the floor of the antrum.

The mucoperiosteal incision was sutured over the canine fossa with 00000 Dermalon without drainage. This surface was painted with compound tincture of benzoin.

The orbit was filled with fluffed plain gauze saturated with penicillin.

One month later clean granulations covered the superior lateral and much of the inferior borders of the orbit.

The fistulous tracts in the soft parts of the right cheek were opened and several pieces of glass removed.

An interval of six weeks elapsed.

STAGE 2. PEDICLED FLAP ON RIGHT ARM. A pedicled flap was outlined on the right arm with its base on the shoulder. Its borders were incised. The portion of this flap which was to become its pedicle was elevated and tubed. The bordering skin was elevated and closed. The borders of the distal flap were sutured (see Pedicled Flaps, p. 8).

It was part of the surgeon's plan to utilize the skin on the posterior surface of the ear for the lid coverings and cartilage from the conchal portion of the ear to represent the tarsal plate supports. This was to be transferred on a tubed pedicle attached to the wrist of the left arm. A skin flap was outlined of sufficient width and length to cover the normal orbital rim. The skin borders of this outlined flap were incised and sutured (Fig. 290 *e f* p. 435).

Three weeks later both the aural and arm flaps were incised, partially elevated and delayed.

An interval of six weeks elapsed.

STAGE 3. TRANSFER OF ARM FLAP AND SO FORTH (Fig. 290, *d*)

1. The arm flap was elevated from the superficial fascia and the bordering arm skin approximated.

2. The nasal mucoperiosteum was incised around the borders of the orbital defect. This tissue was elevated sufficiently to provide adequate (Fig. 290, *d*) approximation with the borders of the skin flap.

3. The distal and inferior margins of the flap were approximated to the mucoperiosteum with loosely tied mattress sutures of 000000 plain catgut. The superior edge of the skin flap should lie on the incised scar border along the top of the defect. Manipulation and suturing here is unsafe.

The skin was incised and elevated around the anterior border of the orbit and sutured to the proximal, superior and inferior borders of the flap with 00000 Dermalon.

4. The shoulder was elevated, the chin partially rotated toward the shoulder and the arm and head fixed and supported in this position with a plaster cap and reinforced arm sling.

Adequate felt was placed over the shoulders and elbow and a piece of light, perforated strap iron was bent to fit over the head and shoulder under the elbow and over the left shoulder. This was included in light plaster bandaging (see Head Cap, p. 103, see also Fig. 290, *d*).

An interval of five weeks elapsed.

STAGE 4. SECTION OF THE PEDICLE. The viability of the entire flap was fully estab-

lished (see p. 11) The pedicle was sectioned, and the bordering skin readjusted and sutured. The base of the flap was adjusted and sutured on the shoulder



Fig. 290 Orbital reconstruction with a major loss of bone and content. This patient suffered trauma from an explosion in a gas furnace. Loss is of the entire soft content of the orbit, the ethmoid lamina, orbital plate of the frontal, the entire floor and orbital margin, and the frontal part of the upper orbital margin. The dura is exposed through the frontal plate. There are foreign bodies in the face, antrum and so on. *a b* and *c* The condition upon arrival some 10 or 12 days subsequent to the accident. *d* Tubed arm flap carrying fat to fill the orbit and replace the loss between the orbit and the nose. This flap forms the base of a new eye socket.

An interval of three weeks elapsed.

STAGE 5 AURAL FLAP: DELAY AND PEDICLE. The borders were incised and elevated and the aural flap was delayed (Fig. 290 *e*)



Fig. 290 (continued) *e* and *f* The outline and preparation of the skin-cartilage tubed pedicle flap to be carried on the wrist to the eye socket for reconstruction of the lids. This thrombosed and was lost. *g* Tubed abdominal flap on the wrist as a carrier A dermal surface of this graft has been skingrafted at *A* *h*, Transfer of the flap prepared in *g* to the margins of the eye socket. *i* The lid flap after amputation of the pedicle. *j* Its horizontal incision to produce the two lid margins. *k*, The finished lids and the socket ready for the reception of a prosthetic shell. (See text on p 433 for complete, detailed discussion.)

A flap was outlined, including the posterior auricular artery at the posterior inferior margin of this aural flap Its anterior and posterior borders were incised to the fascia. The included skin and subcutaneous tissue were elevated and its edges sutured. The bordering skin was elevated and closed with 00000 Dermalon sutures (Fig. 290, *e*)

At intervals of three weeks the ear flap was incised elevated and delayed.

An interval of three months elapsed.

STAGE 6. TRANSFER OF THE AURAL PEDICLE TO THE WRIST (Fig. 290 *e f*)

1 The left arm was placed across the chest with the palmar surface of the hand on the neck and shoulder with the wrist below the lobule of the ear and supported and fixed in this position with a reinforced plaster head cap and arm dressing.

2. A U-shaped flap was incised and elevated on the wrist at the base of the thumb A flap was incised and elevated at the inferior end of the aural tube.

3 This was approximated to the wrist with 00000 Dermalon sutures.

An interval of four weeks elapsed.

STAGE 7 TRANSFER OF THE AURAL FLAP TO THE ARM ITS VIABILITY HAD BEEN ESTABLISHED. It was part of the plan to elevate the flap skin and cartilage with some connective tissue covering later and to graft this surface with thin split skin for the lid lining before transferring it to the orbit.

1 The skin borders of the aural flap were incised and separated from the cartilage for 3 or 4 mm.

2. The cartilage around the flap skin attachment to the perichondrium on the external surface was incised and separated with a blunt elevator

3 A skin flap was elevated on the ulnar side of the wrist and the aural flap transferred to this bed.

4 The plaster dressing was removed and the arm released.

This flap had a satisfactory condition for thirty-six hours and then became slowly ischemic. The condition was such that it was amputated on the fifth day The vessels in the pedicle presented a well-organized mural thrombosis and a more recent occluding thrombosis

A pedicled flap for transfer on the wrist was constructed on the wrist and abdomen (Fig. 290 *g*)

This situation presents an important consideration. If the procedure of choice had permitted use of arm skin in this location where its color and texture is undesirable, much time and effort would have been saved The arm pedicle, which was formerly amputated and scrapped, could have been returned to the arm for cartilage and split skin grafting to provide the lid structure, and finally taken to the orbital margin.

This same procedure now necessitated the abdominal flap its preparation as above, and final transfer to the orbit.

An interval of three months elapsed.

STAGE 8 TRANSPLANTATION OF THE DISTAL END OF THE ABDOMINAL FLAP ON THE LEFT WRIST (Fig. 290 *g*)

An interval of three months elapsed.

STAGE 9 CARTILAGE IMPLANT The radial border of the proximal arm flap *A* was incised and the skin only elevated. A thin layer (1.5 mm.) of cartilage was implanted approximating the size of the orbital opening (18 mm. by 20 mm.) These measurements were the width and length of an oval-shaped piece.

The incision was sutured with 00000 Dermalon. A moderate pressure dressing was applied.

An interval of five weeks elapsed.

STAGE 10 SKIN GRAFT ON THE FLAP CARTILAGE.

1 The lateral borders of the proximal flap were incised.

2. The cartilage was elevated with its connective tissue covering or capsule.

3 Split skin (0.016 inch) was applied to this capsule. The graft was sutured between the approximated skin edges.

4 A dressing was applied with moderate pressure.

An interval of four weeks elapsed.



Fig. 291

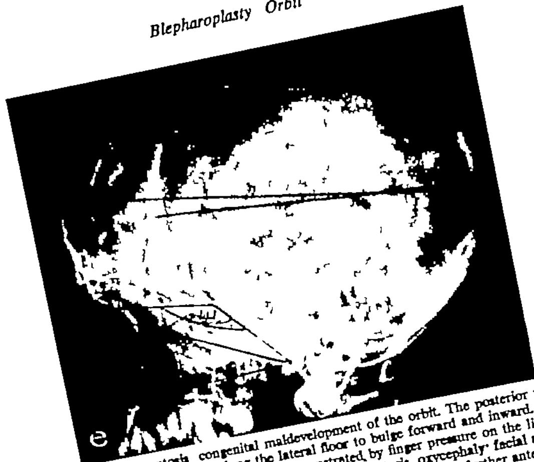


Fig. 291 Proptosis congenital maldevelopment of the orbit. The posterior wall begins at a point ¾ inch along the lateral floor to bulge forward and inward. The position of the globe in the orbit is demonstrated by finger pressure on the lids at the external canthus (*b*) *c*, *d* and *e* Proptosis dysostosis, oxycephaly facial asymmetry *c* Shallow orbits the superior part of the orbit runs much further anteriorly than its inferior portion a cranial facial angle of 70 degrees instead of a normal 90 degrees. *d* and *e* Prints of the anterior and lateral x ray studies with accurate measurements demonstrate the latter

STAGE 11 TRANSFER OF THE LID FLAP TO THE ORBIT

1 The left hand was fixed to the shoulder as described in Stage 6

2. The flap was elevated and its borders were incised to separate the skin from the cartilage and graft.

3 The skin was incised around the border of the orbit.

4 Suture was made with 00000 Dermalon.

An interval of eight weeks elapsed.

STAGE 12. AMPUTATION OF THE PEDICLE. The pedicle was amputated. Shaped cartilage was implanted in the malar orbital border adjusted and sutured, with a small strip of Penrose drain between the orbital skin and the grafted lid lining (Fig. 290, *l*)

An interval of ten weeks elapsed.

STAGE 13 LID INCISION. The lid flap was incised along the horizontal intercanthal line. The external skin was separated from the cartilage to a depth of 2 mm. The cartilage was excised along this line and dressed (Fig. 290 *j* *k*)

Figure 290, *k*, presents the appearance of the socket and lids after three months of organization and softening. During this period an acrylic prosthetic shell was maintained in the socket, which was now ready for a permanent prosthesis.

PROPTOSIS

The exophthalmos may be congenital or acquired it may be either uni lateral or bilateral It is classified on an anatomical basis better than on a

pathological one The latter obviously must be considered as the etiological factor in determining its correction

The management of the condition per se is beyond the function and responsibility of the plastic surgeon There are several types resulting from or accompanying other cosmetic and functional disabilities in which he may valuably cooperate with specially trained surgeons in other fields.

The thyrotoxic and thyrotropic cases should be the responsibility of the skilled ophthalmologist those resulting from defects in the orbital wall resulting from meningocele or mucocele that of the neurosurgeon or the rhinologist, and so forth. This includes some of the space taking lesions, such as dermoid and sebaceous cysts, and so on.

Conditions such as osteoma are the responsibility of the opthalmologist, while tumors such as adamantinoma primary in the jaws and sinuses are the collaborative responsibility of trained rhinologists, oral surgeons and plastic specialists. An example of such a situation is seen in Figure 291 *a b*

Congenital lesions also belong, in other special fields The case pictured in Figure 291 *c d* is uncommon in several respects. The patient, *aged 40 years, suffered a dysostosis (see Fig. 226 p 333) The skull* deformity the marked foreshortening of the orbit producing the proptosis facial asymmetry (bony) and a distorted nose constitute the total abnormalities She enjoys a capable acute mentality normal vision and so forth

The pseudo-exophthalmos cases resulting from trophic absorption and lid retraction are properly the responsibility of either the plastic surgeon or the ophthalmologist.

MICROPHTHALMIA

The correction of this distressing and deforming cosmetic and functional disability enjoys some of the technical progress made in relation to the eye and orbit during recent years

It is not necessary to consider either enucleation and a subsequent ordinary prosthetic eye or enucleation with implantation of the plastic globe of Ruedemann or the more recent vitallium globe of Hughes, with extrinsic muscle attachment and motion in either case The addition of the prosthesis shell in these cases produces excellent results.

The advent and development of contact lenses provides an equal or even better result with greater promise of permanency than the implanted foreign body

Case I. The patient discussed had a double cleft lip and palate with marked protrusion of the premaxilla. These corrections were largely accomplished in infancy and early childhood with normal speech and acceptable appearance. The patient was markedly disturbed psychically at the age of eighteen years by the appearance of the eye.

Lateral canthoplasty was performed by the author and the construction, color and fitting of the plastic contact shell by Dr Ruedemann (Fig. 292, *a, b*)

INTEGRATED EYES AND IMPLANTS

Ruedemann s discussion of the prosthetic restoration of the eyeglobe and the report of his reasoning and research to correct the many criti cisms of the existing practice was an epochal event in 1945

Cartilage globes require meticulous preparation and generally fail to acquire the type of encapsulation resulting in the desired movement.

Gold and glass globes are frequently separated from Tenon s capsule or the sclera by liquid fat and so forth resulting in movement about but not of the globe

Carbonized bone balls slightly heated at the time of installation acquire better adhesion but not dependable movement.



Fig. 292. *a*, Microphthalmia narrow palpebral slit, facial asymmetry *b* Result of correction by canthoplasty and the implantation of a plastic shell prosthesis upon the small globe. (See p. 440 for detailed discussion and procedure.)

The constant shrinkage of orbital tissue and conjunctiva makes perma nent good results impossible with the foregoing technics.

These technics were replaced by another An eye matched in color and size was arranged and processed from plastic. It has around its pos terior center or equator a band of fine tantalum mesh or screen for at tachment of muscles with tantalum wire to its anterior edge Suture is then passed through the muscle and the posterior part of the capsule to draw it forward beyond the wire mesh when tied. This suture is passed through the conjunctiva and tied in a manner to bring the conjunctiva forward of the capsule around the anterior edge of the wire mesh

The new method of Ruedemann and subsequent improvements by his colleagues have obviated the difficulties, prevented the widening of the palpebral fissure and the changes in the inferior cul-de-sac, and vastly

improved the local and cosmetic result. Movement of the globe is perfect in many cases It is predicated on fixed muscle attachment to a non-irritating globe and its firm approximation to Tenon s capsule or the sclera.

Real progress results from collaborative thinking and contribution. Cutler described in 1946 the implantation of a lucite basket with similar muscle suture and a capsule and conjunctival fixation through a sutured stud firmly approximating the basket.

Hughes reported in 1948 a new design of metal implants for use in enucleation the replacement of buried implants of other types and two sizes of a differently designed implant for evisceration All of these are made to receive integrated eyes. They all have standard, exposed flat anterior surfaces (Fig. 293 *a b c d*) to receive the integrated, matched eye in Figure 293 *b* The stud on this eye fits an oval cavity in the implant to prevent rotation.

These implants were made from vitallium because it can be cast as a hollow ball, because there is no shrinkage or change in size or shape, and because it produces no allergic and little tissue reaction It is, however a foreign body which may be ultimately extruded in spite of the unusual tolerance of the enclosing tissues *No foreign body whatever its nature will be retained permanently in body tissue except in rare instances.* A majority of these implants are retained many months and may be replaced if extrusion occurs The excellent cosmetic and psychic results demand this type of management Hughes has eliminated other foreign material, such as silk and other nonabsorbable sutures, and uses plain fine catgut.

The eyes are readily replaced when their color fades Their position and effect are easily changed by relocation of the stud on the posterior surface or by variations in their thickness.

Procedure. This is exact in each possible technical detail to accomplish the desired reconstruction. It is the proper surgical responsibility of the experienced ophthalmological surgeon and is, frequently an essential addition to the accomplishment of the obligation of the plastic surgeon in accompanying injuries to the soft bordering tissues and supporting framework.

The several steps of the procedure follow

1 The conjunctiva from the limbus posteriorly is separated from the underlying tissue by ballooning it with the superficial injection of saline or procaine hydrochloride

2. An incision is made through the tissue anterior to the tendon attachment and posteriorly along the muscular borders to permit elevation of a strip of tissue 4 mm wide and to increase the effective tendon length and allow its suture around the bar of the prosthesis without tension.

3 The tendon is passed between the bar and the prosthetic globe, and folded and sutured on either border to provide the maximum width.

4 Tenon s capsule is brought forward on each side of the tendons,

and incised slightly posterior to form two strips wrapped around the bar and sutured in the manner described.

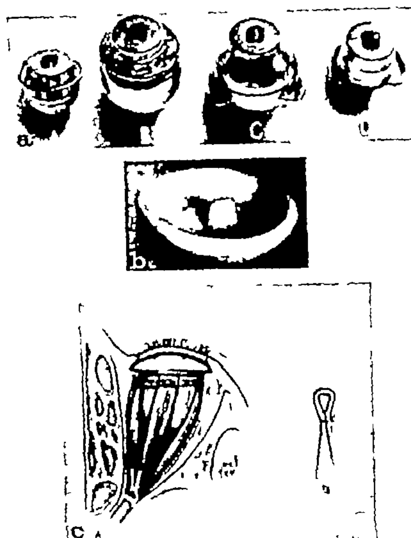


Fig. 293 Integrated eyes and implants. a, Vitallium implants. The letter *A* in this photograph is the size for replacement after enucleation, *B* for insertion at the time of enucleation *C* for evisceration, large size *D* for evisceration, small size. Small size implants (*A*) and (*D*) are approximately 12 mm. in diameter Large size implants (*B* and *C*) are approximately 18 mm. in diameter

b Clear plastic form affording a view of the stud on its posterior surface, fitted into the elliptical opening on the prosthesis during the healing process. This form may be obtained in various sizes. The standard is 22 by 29 mm. *c* Cutaway diagram showing a method of attaching the muscles to the enucleation and replacement type of implant. The evisceration implants are held in place by the anchor bars posteriorly which pass through the sclera. (See text on p. 441 for detailed discussion and procedure.) (Courtesy of Wendell Hughes.)

5 The conjunctiva is fixed around the face of the implant with a running plain catgut stitch

6 A surgical form of clear plastic, affording a view of the stud on its

posterior surface, is fitted into the elliptical opening on the anterior surface of the prosthesis This form may be obtained in various sizes. The standard size is 22 mm. by 29 mm.

A moderate pressure dressing is applied. A mask with a ¾ inch (2 cm) vertical slit is placed over the normal eye to limit its rotation during the first two weeks The dressing on the operated eye remains for two to three weeks if conditions are satisfactory The artificial eye is fitted at the end of this period

The detailed description of Hughes is recommended to the reader

CORNEAL TATTOO

The concealment of corneal scar has a great psychic value Such scars are among the most striking and distressing of the several cosmetic disabilities about the face

Wecker reported in 1871 the first case of staining in which he introduced India ink into the scarred cornea. Williams and Calhoun reported in 1873 the first cases in this country The technical accomplishment aroused little interest between this time and about 1925 when Knapp described a technic in which the scar epithelium was denuded and the cornea painted with 1 per cent gold chloride for two or three minutes. He reported that the reduced gold chloride was deposited as fine dark particles in and between the superficial lamellae further that gold and silver cyanide cobalt and platinum chloride produced no staining

Subepithelial tattooing was recommended by Kerelus in 1926 He circumscribed and elevated the scar except for a small pedicle and painted the under surface with India ink, and then replaced the scar flap

The results were generally disappointing, and little further was done until Pickrell's thorough and excellent research, which resulted in a new method of introduction of a different group of insoluble metallic pigments which are nonirritating in the cornea and the skin and are stable to heat and light. They do not produce stain in the normal cornea.

The stable colors produced—white black blue red orange, yellow and brown—permit blending to obtain the desired result. All were first checked on artificially produced (with formalin) corneal scars on rabbit eyes Special needles were designed for the procedure.

The absence of lymphatics in the cornea probably accounts for the absence of diffusion or change in color which is not true in the skin with its lymphatic structure

A speculum is introduced on each side to permit visualization of both eyes simultaneously the eye is immobilized with grasping forceps applied at some distance from the limbus and the needles carrying the pigment are introduced at an angle of 45 to 60 degrees to make an oblique line (Fig. 294 *d*)

The corneal limbus is accurately outlined with basic color The pupillary margin is similarly outlined. Iris toning is then added with a No 3 needle An oblique direction with care not to enter the anterior chamber is continued throughout.

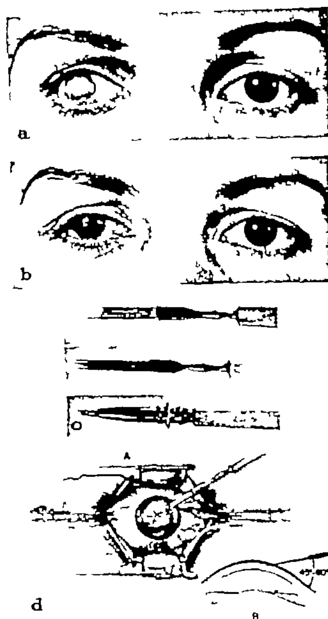


Fig. 294 Corneal tattoo. This patient suffered trauma of the cornea with opacity and blindness at the age of 3 *a*, The initial appearance *b* the finished result. *c* The special needles utilized. *d* Method of exposure of the globe, its fixation with forceps, introduction of dye; *A* is the speculum which should be inserted on each side to visualize both eyes simultaneously The eye to be operated on is immobilized with grasping forceps placed at a considerable distance from the limbus. *B* The tattoo needles are held at an angle of 45 to 60 degrees, so that an oblique line of pigment will result. (See p. 444 for detailed discussion and technic.) (Courtesy of Dr J L Pickrell and E. H. Clark.)

Procedure Incise and dissect two small rectangular flaps from the upper and lower borders of the defect (Fig 295 *a*) Approximate the free ends of these flaps with two or three interrupted horsehair sutures passed from the lateral aspect of the ear Suture the margins of the flaps to the skin margin on the lateral aspect of the ear (Fig. 295 *b*) Elevate a tongue shaped flap with its base downward from the skin covering the mastoid region and transplant it in the defect created by elevating the auricle flaps (Fig. 295 *b c*) Approximate with interrupted horsehair sutures (Fig. 295 *c*) Apply a smooth dressing of gauze behind the ear apply gauze dressing and a moderately firm bandage Remove all skin stitches on the second day Support with strips of gauze and collodion.

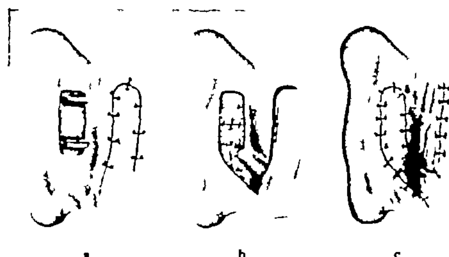


Fig. 295 Small defect of the auricle *a* Lining flaps elevated from the border of the defect covering flap elevated and delayed. *b* Hinged flaps of skin from the mesial surface reflected and sutured to form the external covering skin of the defect. *c* Skin flap from the scalp sutured into the mesial defect.

Method II

Skin from the hairless mastoid region is utilized for the repair

Procedure *Stage 1* Elevate a tongue-shaped flap of skin of proper dimensions from the skin of the mastoid region (Fig 296 *a*) Rotate the end of the flap 90 degrees and suture its distal end and lateral margins to the superior and lateral edges of the external defect in the skin (Fig 296 *b*) Apply gauze dressing and a moderately firm bandage

Stage 2 *An interval of fifteen days is allowed to elapse between Stages 1 and 2*

Check the viability of the inserted flap (see p 11)

Amputate the base of the flap fold it on itself and suture its upper and lateral margins to the borders of the cutaneous defect Undercut the borders of the scalp defect and approximate with interrupted sutures (Fig 296 *c*)

Stage 3 *The interval between Stages 2 and 3 is three weeks*

Adjust the inferior border of the transplanted flap to the inferior margin of the defect, using interrupted horsehair sutures (Fig. 296, *d*)

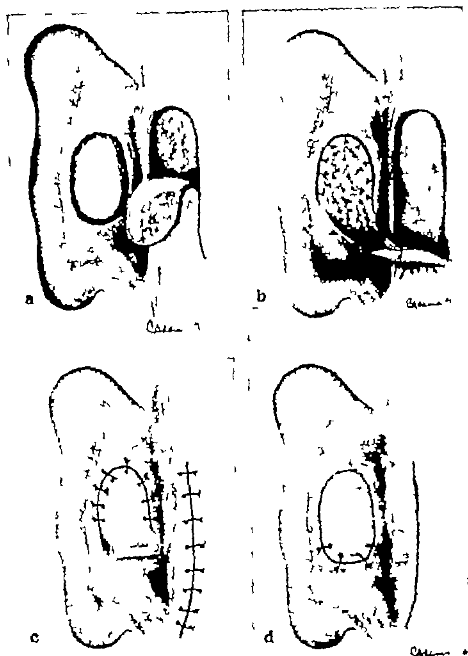


Fig. 296. Large defect of the auricle. *a*, Flap elevated from the scalp for repair of the defect. *b* Rotated flap sutured to the skin bordering the defect. *c* Pedicled flap amputated flap folded on itself to cover the mesial cutaneous defect. *d* Skin fold incised inferior margins of both flaps adjusted and sutured to the bordering skin.

LARGE PARTIAL DEFECT OF AURICLE AND HELIX

Repair with a delayed external covering flap from the mastoid region and a thick intermediate graft.

Procedure. *Stage 1* Incise dissect and delay a flap from the hairless skin over the mastoid region with its base at the margin of the defect (Fig 297 *a*) This flap may require elevation and delaying several times before it enjoys an adequate blood supply (p 11)

Stage 2 Elevate the flap and fold it on itself to furnish covering skin for the lateral surface of the ear and a partial covering for the mesial sur



Fig. 297 Large partial loss of the auricle and helix. *a*, Borders of the defect pared, a scalp flap based on the border of the defect, is incised *b* Flap elevated and reflected forward to approximate the skin margins of the defect externally *c* Flap folded posteriorly to approximate borders of mesial defect split skin graft covering scalp defect in mastoid region.



Fig. 298. *a*, Loss of half of the helix and part of the pinna. *b* Healed condition after a flap of hairless skin posterior to the ear has been elevated, rotated and folded to replace this loss. The scalp was undermined and advanced to close the defect.

face Suture the approximating edges of the flap and cutaneous margins on the lateral surface with interrupted stitches of horsehair (Fig. 297 *b*) Suture the fold in the flap at a somewhat higher level than the adjacent helix to compensate for ultimate shrinkage and contraction Suture the remaining part of the flap to the borders of the defect on the mesial surface of the ear (Fig. 297 *c*)

Stage 3 Repair the remaining defect on the mesial surface of the ear and over the mastoid region with a thick, intermediate skin graft (Fig. 297 *c*) Apply a formed, flattened gauze dressing behind the ear, fluff gauze on the lateral aspect, and a firm bandage Open the dressing on the fifth or sixth day and remove the skin sutures

RESTORATION OF LOBULE (NELATON AND OMBREDANNE)

Procedure *Stage 1* Incise a rectangular flap of proper dimensions with its base on the neck and the distal end in the skin behind the ear (Fig. 299, *a*) Elevate and delay this flap



Fig. 299 Construction of the lobule. *a*, Rectangular flap based on the neck is incised and delayed *b* Flap is sutured to the external skin border of the defect. *c* The base of the flap is excised, folded on itself and sutured to the skin margin of the defect on the mesial surface borders shaped and sutured.

Stage 2 Elevate the distal end of the flap pare the skin on the border of the defect, and suture this to the distal end of the flap (Fig 299 *b*)

Stage 3 An interval of three weeks is allowed to elapse between Stages 2 and 3

Amputate the base of the flap at a sufficient distance from its attachment to the ear to permit folding, with dimensions sufficient for the lobule Elevate the flap and suture it to the skin margin of the defect on the mesial surface Approximate the borders of this folded flap with interrupted horsehair sutures

Stage 4 The interval between Stages 3 and 4 is three weeks

Trim the borders of the lobule to the desired shape and approximate with interrupted horsehair sutures (Fig 299 *c*)

RECONSTRUCTION OF LOBULE (GAVELLO)

Procedure. *Stage 1* Outline a flap one third larger than the required lobule having a base *AF* on the skin of the cheek and neck (Fig 300)

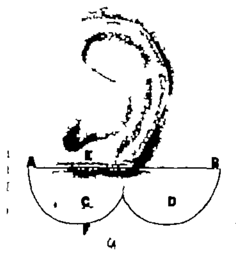


Fig. 300 Reconstruction of the lobule (Gavello) Letters on the face of the drawing are explained in the text.

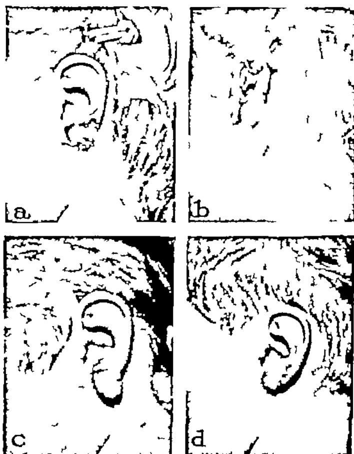


Fig. 301 Pigmented hairy mole of the lobule Gavello reconstruction. *a*, The original lesion *b* the outside line of the flap *c*, the immediate construction of the lobule, *d* the finished result.

Incise the straight line *AB* along the border of the defect of the ear, to connect the ends of the outlined flap Incise and elevate flap *D* and the posterior half of flap *C* Undermine the skin of the base *AF* Return this flap to its bed and delay it three weeks

Stage 2 An interval of three weeks is allowed to elapse between Stages 1 and 2

Again incise the line *AB* the lower border of the flap *D*, and the posterior half of flap *C* (to the point *F*) Undermine flap *C* and the tissue bordering the line *AF* Fold flap *D* on to the mesial surface of flap *C* and suture its upper edge *EB* to the skin bordering the defect on the mesial surface of the ear Suture the superior edge of flap *C* (*AE*) to the skin margin of the defect on the external surface of the ear

Stage 3 The interval between Stages 2 and 3 is three weeks.

Incise the line *AFE* Reduce the lobule flaps to the desired size and approximate their margins with interrupted horsehair sutures (see Fig. 301)

TOTAL AND SUBTOTAL LOSS OF EXTERNAL EAR

The total or large partial reconstruction of an ear has been until recently the most unsatisfactory procedure in plastic surgery The qualities of the tissues involved and the contours required for this reconstruction seemed to preclude its successful accomplishment. The normal ear is thinner than two approximated layers of the average skin of the body The total thickness of the ear is less than that of a piece of costal cartilage which will permit of carving and shaping and still retain its form The best ear constructed from these tissues is bulky and lacks sharp conchal contours and lines It has only a general shape to recommend it.

Cartilage. Kirkham s researches determined not only that heterogeneous elastic cartilage can be used as certainly as rib cartilage, but that it can be taken long after death preserved and utilized. This seemed to make total ear cartilage available as a proper scaffold for a reconstruction and to do much to solve the problem. O'Connor and Pierce have contributed a method of preserving costal cartilage Pierce utilizes struts of this material to accomplish acceptable reconstructions of large partial losses Greeley has utilized maternal ear cartilage after the plan of Gillies to produce an ear of immediate pleasing appearance This procedure is not, however ultimately satisfactory

The best ears have been produced by three procedures discussed in the following text. Both autogenous and preserved homologous cartilage is used The latter has been retained without change in several locations over a long period of time The author feels however that autogenous cartilage should be used in the correction of congenital microtias and so forth or that the parent should understand that the preserved cartilage may have to be replaced at any time during a period of years

Cartilage from the severed parts of the ear in traumatic cases should be stripped of soft parts, thoroughly washed in merthiolate, and planted under the patient s skin until reconstruction can be undertaken.

UNDESIRABLE PROCEDURE FOR RECONSTRUCTION OF EXTERNAL EAR

This case is presented to demonstrate a result obtained from utilizing the skin of the borders of the defect for construction of an auricle over carved rib cartilage and construction of the helix from a tubed pedicle taken from the neck. This cartilage is necessarily thick, to permit of carving and shaping and to prevent ultimate distortion. All the surrounding tissues consist of deep scar and scarred epithelial covering (Fig. 305 *b c d*) Such tissue is not good, ordinarily for this reconstruction

The end result is not good. The constructed ear is several times thicker than normal and the soft coverings sag of their own weight. The ear has little to recommend it other than a general shape and a patent external canal. Much could be done with the tissues at hand to improve the result, but the ear is acceptable to this patient at this stage Such an ear is frequently acceptable to the patient, but should not be satisfactory to the surgeon. The plan of procedure under other circumstances and with better tissue produces an end result acceptable to both the patient and surgeon. This is discussed in the following text.

SUBTOTAL LOSS OF AURICLE AND HELIX

Method I

Reconstruction illustrated in Figure 302 is made over a preserved. homologous ear cartilage

Ear cartilage obtained in the morgue and preserved for a long time is used in this procedure described by Kirkham The cartilage is hardened by soaking in formalin solution for two or three days, thoroughly washed and preserved in an aqueous solution of merthiolate (aqueous merthiolate in physiologic saline solution 1 4) Kirkham s researches with animals, and his subsequent observations on human beings, demonstrated that this cartilage remains unchanged after many months. The cartilage forms a perfect scaffold for support of the soft tissues and produces a normal shape and much of the desired contour

Procedure. *Stage 1* Make a curved incision *AB* (Fig 302 *4*) in the hairline about the periphery of the proposed ear Separate the scalp from the underlying temporal fascia. Perforate a selected ear cartilage in numerous places to permit formation of scar between the soft parts on each surface of the cartilage and thus provide fixation (Fig. 302 *4 C*) Insert the cartilage into the scalp pocket, in the proper location for the new ear Close the incision with interrupted sutures and apply a firm dressing. Prepare a tubed pedicle with its base over the tip of the mastoid process and of sufficient length to cover the periphery of the ear This tube should not exceed ⅜ inch (1 cm) in diameter (p 16 Fig. 18)

Stage 2 An interval of two months is allowed to elapse between Stages 1 and 2.

Make the incision *DE* through the scalp to outline the border of the auricle of the new construction (Fig 302 *4*) Dissect the included flap

and cartilage to leave soft tissue on the mesial aspect of the cartilage (Fig. 302, *5*) *Mold sterile dental modeling compound to the back of* the ear and the defect in the scalp Cover this mold with thick, split skin raw surface outward, and return it to its bed Dress the ear with fluff

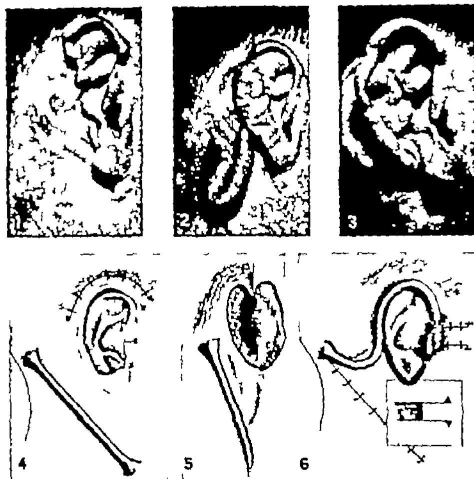


Fig. 302. Subtotal loss of the auricle and helix. 1 Shaped, preserved cartilage planted on the border of the defect in the mastoid region, *2* tubed flap transplanted to the edge of the reconstructed ear *3* tubed flap arranged to form the new helix, *4 AB* incision for implantation of cartilage through hair bearing area of scalp *C* implanted aural cartilage, *DE* outline of auricle line of incision for second-stage operation *5* the ear has been incised along the line *DE* and reflected forward with the implanted cartilage attached the raw surface on the ear and the scalp is covered with split skin, *6* the distal end of the tubed flap is draped over the anterior and superior surfaces of the helix, a rectangular skin flap is folded on itself and sutured to form a new tragus, a sliding flap from the face closes the resulting defect in the skin.

gauze and a firm bandage Remove the dressing and the mold after eight to ten days. Dry the graft in the air return the mold, and reapply a dressing with moderate firmness. Repeat this dressing at intervals until the graft is thoroughly organized.

Stage 3 An interval of three to four weeks elapses between Stages 2 and 3

auricle of the proposed construction (Fig. 303 *6*) Elevate the scalp and cartilage struts, leaving soft tissue on the mesial surface of the



Fig. 304 Total loss of auricle. *1* Loss of entire ear except lobule and tragus *2* the scalp flap and cartilage have been reflected outward and resulting raw surface covered with split skin applied on a mold the anterior end of the tubed flap has been transplanted below the lobule *3* the mold has been removed from behind the ear the skin graft is in a state of organization the posterior end of the tubed flap has been transplanted to the mastoid region ("caterpillared") *4* the tubed flap has been draped around the margin of the reconstructed auricle *5* cosmetic corrections have been made in the helix and auricle. (G W Pierce Surg., Gynec. & Obst., March, 1930)

cartilage Mold sterile dental modeling compound into the pocket thus created cover it with split skin raw surface outward and reinsert the mold (Fig. 303 *2 3*) Close the edges of the scalp with interrupted su

tures of horsehair Apply a firm dressing for seven to ten days Transfer the median attachment of the tube to the region of the tip of the mastoid process (Fig 303 *2*)

Stage 3 An interval of ten days is allowed to elapse between Stages 2 and 3

Open the incision in the scalp and remove the mold Dry the graft in air and reinsert the mold. Apply a moderately firm dressing. Repeat this dressing at intervals until the graft has become thoroughly organized

Stage 4 The interval between Stages 3 and 4 is one month

Transfer the new inferior attachment of the tubed pedicle to the location of the anterior inferior position of the helix Open the scar of the line of incision in the tube for part of its length and drape it on the superior surface of the helix (Fig. 303 *3*)

Stage 5 An interval of three weeks passes between Stages 4 and 5

Amputate the mastoid attachment of the tubed pedicle Open the scar along its line of incision and complete its arrangement on the border of the helix

The various stages of the reconstruction for partial loss are pictured in Figure 304 These stages of repair are followed in the reconstruction for either partial or total losses. The very acceptable result of this reconstruction is pictured in Figure 304 5 The lobule of the ear in a case of total loss, can be constructed from the tubed pedicle or after the plan of Gavello (Fig. 300) Construction of a tragus is pictured in Figure 302, *6*

ATRESIA OF EXTERNAL CANAL AND SUBTOTAL LOSS OF EXTERNAL EAR

The cases under discussion here result from chemical burn in two instances and trauma in the other The scar formation varies considerably and to a large degree, determines the plan of correction.

The canal can be reconstructed by utilization of *bordering skin flaps* or by application of a *skin graft over a mold* after dissection of the scar The scarred epithelial surface of a burned area is usually useless for formation of a flap for a long period of time after healing of the burned surface has occurred If such flaps are used early they usually melt away promptly after transference and result in increase of the scar and contraction in the repaired area

The atresia resulting from trauma (Fig. 307 p 461) and from burns involving the canal per se is best and simply corrected with a minimum of postoperative care by a *Z type of plastic*

Procedure for Reconstruction of Canal by Skin Grafting over Mold. Prepare the external surface scrupulously Dissect the scar tissue and the underlying subcutaneous tissue until the canal obtained is larger than the desired size Make a mold of sterile modeling compound to fit the cavity Cover the mold with a single piece of intermediate split skin raw surface outward. Insert the device in the prepared cavity Dress with gauze and a firm bandage

Remove the dressing and mold in six to eight days Dry the cavity in

the air and reinsert the mold. This dressing is continued at intervals until the graft has become thoroughly organized. It is wise to continue the use of an obturator for several weeks A piece of hard walled rubber tubing answers this purpose This should be removed for short periods at frequent intervals to prevent maceration of the grafted skin (Fig. 305 a)

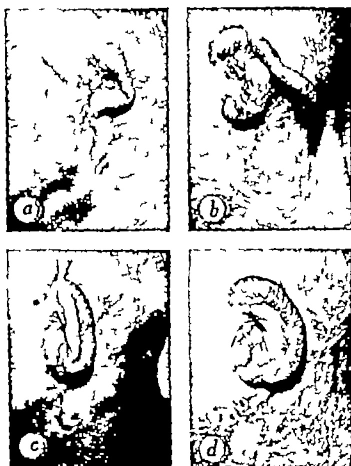


Fig. 305 Total loss of the helix, partial loss of the auricle, and atresia of the external canal. a Reconstructed ear canal. b Construction of the auricle with hairless scalp from the mastoid region attachment of a pedicle from the neck to replace the helix. c Complete distribution of the pedicle from the neck on the auricle. d Result of this reconstruction 2 months later

ATRESIA OF THE CANAL—Z PLASTIC

Scar contraction in an atresia is annular—of the "purse string" type. It occurs in the area of deepest destruction, and draws the scarred or normal skin from both the lateral and mesial surfaces of the canal to the borders of the strictured opening. The scar tissue is deepest and thickest in this area (see Fig. 307 a f p 461)

The circumference of the stricture opening is much less than that of the normal canal. It is comparable to the scar contractures on flexor surfaces (fingers elbow axilla, and so forth) or on the neck. It permits similar

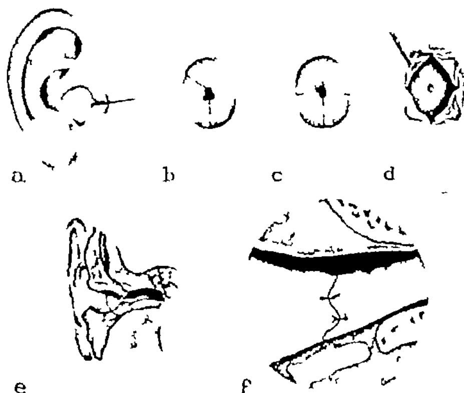


Fig. 306 Atresia of the canal *a* The original atresia *b* and *c* two types of incision for the external skin flaps from the canal, *d* the incision of the skin of the mesial canal *e* lateral section of the ear and canal, showing the location of the stricture at the junction of the cartilaginous and bony canal *f* the suture line of the integrated flaps. (See p 460 for a detailed discussion of the procedure)



Fig. 307 *a* Atresia of the canal, resulting from trauma. *b* Result of a Z plastic procedure described in the previous figure and in the text on page 460

correction Stricture of the nostrils is readily corrected in a similar manner (see Fig. 338, p 510)

Procedure.

1 Incise or pare the borders of the stricture (Fig. 306 *a b e* p 461)

2 Divide and mark the cone-shaped skin surface (Fig. 306 *e*) from the canal wall to this opening in thirds or quadrants with dye Steffensen *has recently described the latter division, which* makes the subsequent distribution of flaps easier and smoother (Fig. 306 *b c*)

3 Insert a right angled knife in the pared stricture between the lateral and mesial layers and separate freely

4 Incise the lateral skin *only* along the division lines. Insert a sharp hook into the points of the flaps and dissect them to the normal canal wall. This brings to view the skin with the pared stricture opening in the mesial part of the canal. Mark this skin in quadrants in lines bisecting the bases of the external flap (Fig. 306 *d*)

5 Incise along the lines just determined and dissect the four flaps free from underlying scar

6 Interpose the points of the several flaps and fix with 0000 silk.

7 Dress the canal lightly with narrow ribbons of Furacin gauze (Fig. 306 *f*)

Figure 307 depicts the result of this management in an atresia resulting from trauma.

Case L Chemical (Acetate) Burn; Destruction of the Canal and the Cartilage and Skin of the Concha and Pinna. The ear with the exception of a part of the helix and lobule, was reconstructed from local tissue in ten stages.

Procedure· STAGE 1 The superior portion of the helix was sutured to the scalp along the line of the new ear A split skin-graft (0.012 inch) was applied to the burned area and ear canal.

An interval of three months elapsed.

STAGE 2. The superior helix was repositioned on the scalp.

An interval of one year elapsed.

STAGE 3 A supraclavicular tube 4 inches long was constructed (Fig. 308 *b*)

An interval of two months elapsed.

STAGE 4 A Gavello flap was outlined and its posterior half elevated and delayed (Fig. 308 *c*)

An interval of three months elapsed.

STAGE 5 The medial end of the tube was transferred to the neck, inferior to the ear The Gavello flap was incised and the posterior flap undermined and delayed (Fig. 308 *c d*)

An interval of six months elapsed.

STAGE 6. The lobule was constructed from the Gavello flaps. Surgical adhesion supported the posterior portion of the helix.

An interval of three months elapsed.

STAGE 7 The distal end of the clavicular tube was attached to the mesial surface of the lobule. The defect in the lower third of the helix was further repaired with an elevated flap from the mastoid area.

An interval of five months elapsed.

STAGE 8 The pedicle was excised from the neck and rotated to form the helix of the new ear

An interval of seven months elapsed.

STAGE 9 Autogenous cartilage from the sixth and seventh ribs was approximated and carved in the form of an ear and implanted.

An interval of three months elapsed.
STAGE 10 The anterior helix was repositioned
The result of these procedures is presented in Figure 308 *h*.



Fig. 308 Atresia of the canal following a chemical burn with acetate. This destroyed cartilage and skin of the pinna and concha. The canal was repaired with a split skin graft.

a The condition 3 weeks after the injury Stage 1 the superior part of the helix was sutured to the scalp along the line of the new ear Split skin graft (twelve-thousandths) was applied to the burned area and ear canal. *b* Stage 3 construction of a supraclavicular tube. c Stage 5 the medial end of the supraclavicular tube transferred to the neck inferior to the ear Gavello flap incised and posterior flap undermined delay Stage 6 lobule constructed from Gavello flaps surgical adhesion supporting posterior part of the helix. Stage 7 distal end of clavicular tube attached to medial surface of lobule defect of lower third of the helix further repaired with elevated flap from mastoid area. *f* Stage 8 pedicle excised from the neck and rotated to form the helix of a new ear *g* Stage 9 autogenous cartilage from sixth and seventh ribs approximated and carved in the form of the desired ear and implanted *h* Stage 10 the result of these procedures. (See *p* 462 for a detailed description and the procedure.)

MALIGNANCY

The various malignant lesions of the ear and its bordering tissues demand the same radical management as elsewhere The ear structure and its lymphatics, however exclude a common type—radiation—of procedure because its cartilaginous framework does not permit of adequate destructive dosage of its covering soft parts. The early basal cell lesions

may be properly destroyed with the high frequency current, but wide excision and reconstruction is the safest and most satisfactory procedure. The resulting reconstructive problem obviously depends upon the kind



Fig. 309 Basal cell carcinoma of the pinna, wide excision. *a*, The original lesion. *b* and *c* Wide excision. Reconstruction is accomplished by a rotated flap of hairless skin from the mastoid area and the later introduction of carved, preserved cartilage. *d* *e* and *f* The result of this procedure.

and extent of the lesion and may vary from repair of small areas to total reconstruction of the ear and its supporting bony tissues.

The case in Figure 309 is presented to illustrate the wide excision of a squamous lesion 3 mm. in diameter and the one in Figure 310 a similar management of a more advanced and larger lesion.

CONGENITAL ABNORMALITIES

These vary from total absence of all parts to excessive development, they include aberrations, distortions and supernumerary parts and partial development of parts which, in consequence, produce developmental dis tortions of normal constituents

The congenital maldevelopments, as well as the nevi, vascular defects, and so forth occur in the ear, as elsewhere in the body



Fig. 310 Malignancy *a* Wide excision of a squamous cell lesion 3 mm. in diameter a rotated interpolated flap of hairless skin from behind the ear the scalp elevated and advanced to close the defect. *b* The healed result after the amputation of the flap

Aberrant Tragus, Cleft Canal, Lobule and Misplaced Lobule

This ear presents a midvertical cleft of the lobule and the floor of the canal along one half of its cartilaginous portion The tragus cartilage is displaced and enlarged to fill the canal. The posterior half of the lobule presents excessive connective tissue and skin development at its attach ment to the pinna and helix.

Procedure. *Stage I* Incise the skin from point *A* to *B* and carry the incision through the mesial skin attachment of the lobule about point *B* (Fig. 311, *a b* p 466)

Elevate the cheek skin for 3 mm anterior to this incision.

Make a vertical incision through the middle of the skin over the aber rant cartilage and free this skin on both sides. Excise the cartilage and carve it to the desired shape for the tragus

Split the connective tissue in the lobule from the point *B* and implant the cartilage. Rotate this part of the lobule upward and posteriorly to locate the tragus as desired Suture its anterior approximated border with 00000 Dermalon.

Pare the margins of the cleft. Approximate Suture Dress with strips of lightly packed Furacin gauze and fluffed gauze covering.

The parents of this child were pleased with this incomplete result and desired no further change The final stage of the original plan will be described, however

Stage 2 Make a V-shaped incision point up in the scar inferior to the canal and up to the base of the new tragus Excise the included scar (Fig. 311 *c*)

Undermine the lobule skin over the pinna and to the helix.

Free the high mesial attachment of the lobule, and rotate it upward and forward to approximate the base of the tragus. Suture and dress.



Fig. 311 *a*, Congenital abnormality aberrant tragus, cleft canal, lobule and misplaced lobule. *b* The result of the procedure. (See p. 465 for detailed discussion and procedure.)

Protruding or "Lop" Ears

These are congenital conditions resulting from one or more of several deficiencies or combinations of these The normal ear protrudes from the skull about 25 or 30 degrees The absence of the curved bend, anti helix, between the conchal and pinnal cartilages will cause the pinna and helix to stand some distance from the scalp—it may even rest at a right angle The conchal cartilage may be excessive in depth, or a combination of the two things may produce this disability

A deficiency in the skin of the helix results in various deformities.

It is obvious that no one fixed procedure is adequate to correct the several congenital disabilities. One producing acceptable corrections of "lop" ears is presented.

Procedure. Fold the pinna mesially to produce the line of the antihelix. Dip a medium bore (21) hypodermic needle in methylene blue, and puncture dots from the external surface through the cartilage and mesial skin After withdrawing the needle dip it in dye and stain the puncture hole in the medial skin These dye marks are plainly visible guides in the skin and cartilage throughout the procedure

Incise the mesial skin and perichondrium the entire length of the dotted

line It is important that this incision continue to the end of the superior crus or crura of the planned new antihelix, and also well down to the antitragus

Separate the perichondrium on either side of this incision with an elevator for 3 or 4 mm

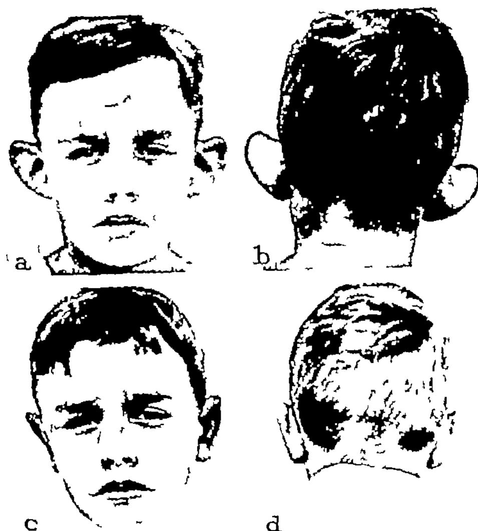


Fig. 312. Protruding or lop ears This condition results from the absence of an antihelix and a faulty attachment of the anterior end of the helix. *a* and *b* The initial condition *c* and *d* the result of the procedure. (See p 466 for detailed discussion of this procedure.)

Incise the cartilage along the dotted line to the perichondrium on the external surface. If the conchal cartilage is not abnormal in height, this incision is sufficient to complete the desired change Otherwise make a second incision through the conchal cartilage parallel to the first and of sufficient width to permit the pinna to lie in the desired position after this strip of cartilage is removed.

It is neither necessary to thin and bend, nor to make multiple parallel incisions ("lobster tailing") at intervals of 1 or 2 mm along the anti-

helix line to produce the desired rounded edge of the new antihelix. The latter frequently suffers scar contractions and irregularities.

Pass four or five 00000 plain catgut sutures through the edges of the approximated pinna and conchal cartilage and tie just sufficiently to approximate the edges and let them turn slightly

Suture the perichondrium with a few similar stitches.

Suture the skin with a running 00000 Dermalon stitch.

Place a thin, crescent-shaped piece of eye pad (fine-meshed gauze en closing cotton) between the scalp and the pinna (Fig. 313 *g* p 469) Fix narrow strips of 30 mesh gauze with collodion (U.S.P) radially in the concha up to the incision. Determine that the sutured cartilage is not overlapping and that the curved skin edge is desirable Put tension on the individual strips around this curve, across the pinna and on to the scalp to fix the pinna firmly on the pad dressing close to the scalp Place adequate collodion on the strips over the curved helix edge These strips remain until the running skin stitch is removed on the tenth or twelfth day

Place 30 mesh gauze in the concha and over the ear Pack all cavities moderately with cotton. Place an eye pad over the ear and fix this with moderate pressure with a wide strip of fine gauze with collodion to the face in front of the ear and the scalp posteriorly Cover with fluffed gauze and a mastoid bandage of Gauzetex

Open the dressing on the tenth or twelfth day to remove the skin stitch Reapply the collodion strips to the scalp and continue the dressing for another week. Remove all dressing at this time but continue to hold the pinna against the scalp with two or three collodion strips for an additional two weeks.

The scar forming along the sutured perichondrium and encasing the approximated cartilage will *rarely* contract from its extremities sufficiently to bend the pinna slightly forward In this event, the skin incision must be reopened, the perichondrial scar offset (staggered) and the ear redressed.

This procedure has produced uniformly desirable results over a period of years.

Deficiency of the Helix

This congenital defect—varying degrees of shortness or displacement of the soft tissue constituting the helix—results in abnormal growth of the pinnal cartilage and types of lop ear The correction requires, obviously the lengthening of the helix and correction of the cartilage to permit return to its normal position. The case presented in Figure 313 (*p* 469) demonstrates both types of correction.

The required length of the helix is obtained from the hairless skin in the area of the antihelix and that anterior to the ear out to the hair-bearing skin. See Total Ear (p 479) for further discussion also the correction in Figure 312, in which this condition of the helix is an important factor

Procedure. Make a curvilinear incision from the top border of the helix attachment to its normal termination above the tragus. Carry this incision along the border of the hair-bearing skin. Make a second parallel incision of maximum width from the external grooved line of attachment of the helix to the tragus



Fig. 313 Protruding or lop ear due to deficiency of the helix and lack of an antihelix. *a b* and *c* The original condition *d e* and *f* the finished result, *g* the method of obtaining an additional helix and its elevation, also a desired, efficient type of dressing during the period of healing and scar organization *h*, the finished result. (See p. 468 for detailed discussion of the condition and procedure.)

Elevate this skin and the base attachments from the fascia. Tube this skin flap with several loosely tied mattress sutures to maintain its form (Fig. 312 *a b c g* p 467) Elevate the bordering cheek skin and fix it in proper position with anchor stitches of plain 00000 catgut. Mark the superior end of the antihelix with a needle and dye (see Lop Ear p. 466)

Incise the skin on the mesial surface along this line Separate the skin and perichondrium for several millimeters with an elevator

Incise the cartilage along the dotted line to the perichondrium on the external surface Make the required parallel incisions in the cartilage of the top of the pinna to permit this to lie flat.

Approximate the cartilage along the antihelix incision with several loosely tied sutures of 00000 plain catgut. Suture the perichondrium in the same manner Close the skin with a running stitch of 00000 Dermalon Suture the new formed antihelix to the bordering skin edges with 00000 Dermalon (Fig. 313 *g* p 469)

Place a thin crescent-shaped piece of eye pad (see Lop Ear p 466) between the ear and the scalp Fix the antihelix curved edge of cartilage and skin the pinna and so forth in position to the scalp with strips of 30 mesh gauze applied with collodion (U S.P) (see Fig. 313 *g*)

Cover the ear with 40 mesh gauze pack all cavities moderately with cotton and cover with an eye pad fixed under moderate pressure to the cheek and scalp with a strip of gauze applied with collodion.

Open this dressing in ten to twelve days to remove the running stitch, and reapply Retain it for another two weeks. Then remove the dressings and retain two or more gauze strips holding the ear against the scalp for an additional two weeks until the new fibrous tissue is fairly well organized

The original situation is pictured in Figure 313 *a b c* and the dressing with result in Figure 313 *d e f g h* See Figure 312 *a* (p 467) in which the helix is a factor in the deformity

Macrotia

The height and width of the pinna must both be considered in the plan of reduction, which should be accomplished with a minimum of visible scar The procedure described by Lexer permits concealment of the long scar in the sulcus of the helix, leaving visible only the fine transverse scar across it.

The requirement is not rare in bilateral congenital cases and is frequently essential to the balancing of the two ears, after the construction of a normal-sized one to replace a unilateral microtia.

Procedure. Outline with dye across the antihelix and on the pinna the desired size of the ear This, of course, considers the width of helix to be added to this outline

Make an incision through the skin and cartilage high in the sulcus from the anterior border of the antihelix to about the upper level of the tragus. Make a second parallel incision through the skin and cartilage along the line marked with dye.

Remove this semilunar-shaped piece of cartilage This leaves the perichondrium and mesial skin covering exposed.

Excise a wedge-shaped (base on the helix) piece of this skin and helix of sufficient angle to permit accurate approximation without tension.

Pass 00000 Dermalon stitches to *invert* the approximating edges of the skin of the helix and pinna

Approximate the helix with horizontal mattress sutures which evert the edges under moderate stitch tension

Adjust the skin folds on the mesial surface to produce a smooth covering.

Dress as in the preceding two cases (p 470)



Fig. 314 Diagrammatic presentation of the procedure for the correction of a macrotia. (See p 470 for discussion of the detail of procedure.)

Hemangioma—Capillary and Cavernous

All degrees of each type and combinations of these are present in the ear The author's conception of a satisfactory management has been stated as noted on page 234 and the following.

Case I. This pulsating lesion involved the lobule and inferior part of the concha. The skin covering the mesial surface was normal.

Procedure Excision of Lesion, Ligation of Afferent and Efferent Vessels (Fig. 315)

STAGE 1 Rubber-covered clamps were applied on either side of the lesion. Its borders were incised to the mesial corium. The enclosed tissue was also incised. The border vessels were ligated

A flap was incised, base inferiorly from the hairless mastoid skin, elevated from the periosteum, rotated and interpolated in the defect, and sutured with 00000 Dermalon (Fig. 315)

An interval of several months elapsed.

STAGE 2. INCISION OF BASE OF THE FLAP COSMETIC ADJUSTMENT The base of the flap on the neck was incised.

The neck defect was closed at the flap base. The desired border adjustment of the flap on the lobule was made, allowing for scar organization. Figure 315 *e* presents the result one month after this stage.

Case II. This case is presented as an example of one of the extensive involvements of the entire external ear surrounding temporal, parietal and occipital scalp, and the surrounding cervical tissue (Fig. 316)

The basic principles of its management do not vary from other cases presented in detail.

Case III. Capillary and Cavernous Hemangioma; Radium Ulceration and Suppuration. This patient was presented in 1927 at the age of two and one-half months, with the congenital lesion noted, and a marked radiation ulceration and suppura-

tion. The extent of the lesion is obvious in Figure 317 a. The patient had two marked outstanding ears in addition to the vascular disability.

The effect of the radiation in the short period since its application produced surface skin changes, but no appreciable deep sclerosis. It was desirable to ligate the afferent and efferent circulation remove the lesion and replace the scar with normal skin by multiple excision.

Procedure At the age of 3½ months Ligation of Afferent and Efferent Vessels; Excision of the Major Part of the Lesion.

STAGE 1 A heavy (No 1) continuous, quilting Dermalon stitch was passed deeply around the entire mass about ½ inch from its borders, and pulled tightly and tied

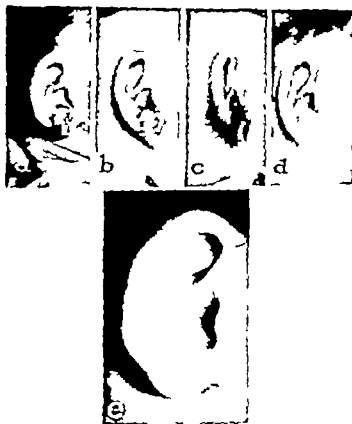


Fig. 315 Case I hemangioma of the lobule and inferior margin of the concha, excised and repaired by a rotated, interpolated hairless skin flap from the mastoid area. *a* The original condition *b* and *c* the origin and approximation of the posterior flap *d* its healed condition *e* the finished result after amputation and folding of the flap. (See p 471 for detailed discussion of the procedure)

An incision was made around the cheek margin, beginning at the border of the mandible and proceeding across the superior margin of the lesion to the tragus, then down along the attachment of the ear around the lobule upward along the posterior ear attachment and around the superior border to terminate at the lower hair line

The anterior mass was ligated and dissected from the temporal vessel, parotid fascia, and so forth.

The cheek was elevated above the fascia over the submaxillary triangle and down the neck for several centimeters.

The cheek and neck skin was rotated and advanced to approximate the incised anterior ear attachment (see Multiple Excision, p 341)

The dissection of the mass was continued posteriorly across the neck to the normal scalp and cervical skin. These structures were elevated above the fascia (preserving the occipital artery) The procedure was simplified by clamping and excising the anterior half of the mass along a vertical line through the posterior aural sulcus.

Heavy vertical mattress sutures were passed through the posterior margin of the lesion and the free edges of the cheek and neck skin, drawn tightly and tied (see

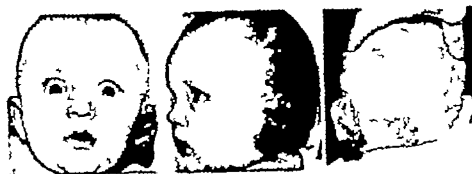


Fig. 316. Case II extensive cavernous hemangioma.

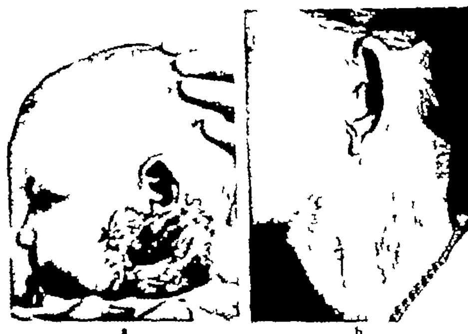


Fig. 317 Case III cavernous hemangioma presenting result of radiation. *a* The condition at the age of 3½ months *b* the condition 22 years later The protruding or lop ear is a congenital disability which is in no wise related to the nevus. (See p. 471 for a detailed discussion of the condition and procedure.)

Multiple Excision, p. 341) This determined the exact amount of the remaining involved tissue which could be excised, and allowed simple closure. It permitted removal of the major posterior portion.

Excision was done. All marginal vessels were ligated carefully The approximating edges were sutured with subcuticular 00 plain catgut anchor stitches, and the surface with 00000 Dermalon.

The remaining mass was incised along the posterior border of the sternomastoid muscle. Both sides of the incision were dissected and managed as above.

The running ligature was removed.

A dressing of fluffed gauze was applied with moderate pressure.

An interval of eight weeks elapsed.

STAGE 2. REMOVAL OF RESIDUAL LESION. The capillary hemangioma of the helix and lobule had largely disappeared as the result of vascular sclerosis. There was considerable scar bordering the visible lesion on the neck as the result of tension and sclerosis. The procedure repeated the essentials of Stage 1

An interval of one month elapsed.

STAGE 3 MULTIPLE EXCISION OF SCAR, ADVANCEMENT OF NORMAL ANTERIOR AND POSTERIOR CERVICAL SKIN. The original scar was incised from the anterior ear attachment to the angle of the mandible. The incision was carried down the scar margin in the lateral neck.

The skin was elevated freely on the neck to both the anterior and posterior midlines.

Traction mattress sutures were passed, and the essentials of Stage 1 were repeated. The entire scarred skin could be removed by this process. The patient had no desire, however to remove the scar or correct the ears. Figure 317 *b* presents the appearance after twenty-two years.

Case IV Pulsating Capillary and Cavernous Hemangioma, Outstanding Ear; Absence of Antihelix. This case is presented because of several interesting developmental and growth type features as well as the accompanying congenital maldevelopment of the cartilage.

The congenital vascular bud mass on the mesial surface canalized to produce large pulsating vessels and a cavernous mass 1 inch (2.5 cm) thick. There were two afferent linear vessels on the external surface. One originated in the antihelix, the other on the lateral wall of the conchal cartilage. The skin, to the sulcus of the helix, presented only objective capillary lesions. These capillaries dilated later and a cavernous area developed when these were on tension after surgery This tendency of such vessels to dilate and become visible has been discussed on page 234

Procedure STAGE 1 A continuous, quilting suture of 0 Dermalon was passed through the scalp from the lobule along the posterior attachment of the ear to its anterior superior end, put on tension, and tied tightly

A similar suture was passed along the entire posterior margin of the helix.

A curvilinear incision was made on the mesial surface through the skin along the line of the normal antihelix. This skin was elevated from the vascular mass, which was clamped and excised from the perichondrium.

The quilting sutures were released, and all bleeding areas were ligated completely

The excess skin was excised and the skin approximated with 00000 Dermalon sutures.

A shaped eye pad was placed between the ear and the scalp. The concha and cavities were filled with cotton. Fluffed gauze was applied and a firm Gauzetex bandage.

An interval of six weeks elapsed.

STAGE 2. LIGATION OF EXTERNAL AFFERENT VESSELS CONSTRUCTION OF ANTIHELIX EXCISION OF EXCESS MESIAL SKIN COVERING. The original scar was incised and this incision carried through the perichondrium.

The ear was held against the scalp to outline the desired antihelix. This line was marked with a needle and dye passed through the external skin (see Protruding Ears, p. 466)

The skin and perichondrium were elevated 2 or 3 mm. on either side of the incision. The skin was separated from the perichondrium over the helix and on the external surface of the pinna.

The entrance of a large linear afferent vessel was located in the antihelix and one on the posterior wall of the concha. The vessels were ligated.

The cartilage was incised along the dotted line to the perichondrium on the external surface as discussed on page 466 the cartilage and the perichondrium were then sutured as discussed there.

The helix was readjusted. The excess skin was excised and the approximation sutured with 00000 Dermalon and dressed as discussed on page 470.

STAGE 3 SCLEROSING CHEMICAL INJECTIONS (SODIUM MORRHUATE) The patient was seen ten weeks after discharge with an enlargement (thickening) of the skin

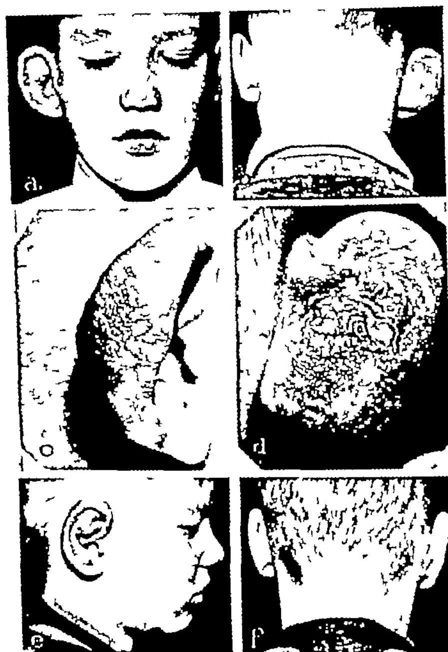


Fig. 318 Case IV pulsating cavernous hemangioma. (See p. 474 for detailed description and procedure.)

covering the helix and the pinna. There was a visible cavernous area at about the midpoint of the helix, which measured 1/4 inch by 5/16 inch (0 04 by 0 18 cm.) There were areas presenting visible dilated capillaries in both the superior and inferior areas of the helix and pinna.

One minum of 5 per cent sodium morrhuate was injected in the midcavernous area.

The patient was checked and received injections at six weeks intervals after this. On the third occasion a minum was injected at the junction of the helix and pinna both superiorly and inferiorly The condition was much improved six weeks later At the end of the fifth period of six weeks the injection was repeated.

The result, except for hemosiderin pigmentation, as seen in Figure 318, e f h very acceptable.

Absence of All of Ear except Lobule—Congenital and Traumatic

It has been stated previously that the reconstruction of the total ear has been until recently the most unsatisfactory procedure in plastic surgery The qualities of the required tissues involved and the contours essential to an acceptable result seemed to preclude the desired construction.

The early work of Kirkham, Pierce, and O Connor and others materially improved the usual results and provided the basis of two of the present definite accomplishments. Several contemporaries have pooled interests, suggestions and ideas which have inspired notable progress The accomplishments of Aufricht and Peer in a field of new technic are outstanding examples. Other contemporaries produce acceptable results with modifications of the plan of Kirkham and others.

The *main objective* of the reconstruction *is cosmetic* The restoration of function is impractical in the average congenital case because of mal*development of the tympanic membrane and the tympanum* The author has obtained the maximum anatomic results in several cases during past years with the conviction that the functional results in no wise warrant the effort of either the patient or the surgeon Some function may be added in the traumatic case.

The new ear should duplicate the normal as closely as possible It should have the approximate size, same shape or contours position and relation to the scalp

The requirements are best planned on an acrylic model of the normal ear taken from a mirror model of the existing ear This is essential in following either of the technics subsequently described.

The planning and treatment of the external skin covering of the new ear are vital to the desired result. Grafted skin in the author s experience defeats its purpose Its contraction regardless of the age of the fibrous tissue *infiltrating or encapsulating the supporting, modeled cartilage* destroys its lines and carvings The source of full thickness skin should be the hairless area about the defect, if possible or from the supraclavicular neck area.

A case in which skin from the upper arm was utilized some years before our present knowledge is presented to demonstrate its criticisms

Congenital Microtia

Brown has completed a long research to determine the relationship *between the infant and adult ears* The value lies in the determined age at which the infant ear has developed to within a few millimeters of the size of the adult one This is a fact at the age of five and perhaps,

younger The measurements below the age of five have not been completed

It was noted that one third of all ears measured 40 by 60 mm. that if two other measurements, 35 by 55 mm. and 50 by 70 mm. were used, three molds may be made, one of which will match the normal sized ear within 2 or 3 mm

The variance in vertical measurement results from the size of the lobule rather than the cartilage The lobule may be easily varied to provide the desired length. This permits not only useful, accurate measurements of the existing normal ear for reconstruction but relieves the necessity and labor of mirror images, molds, and the like in any of the reconstructions other than a diced cartilage framework These may be safely produced, as conceived by Brown and Peer in standard stock molds

Requirements. External and mesial covering skin and cartilage supporting tissue A tubed pedicle based on the shoulder and shaped autogenous cartilage are used. Preserved, instead of autogenous, cartilage can be employed. This repair was effected before the present conception of total and partial otoplasty

Procedure. *Stage 1* A pedicle is tubed on the arm as described in Figure 3 and is transferred to the side of the head. A dressing such as is depicted in Figure 8 is used.

Stage 2 The interval between Stages 1 and 2 is four weeks

The pedicle is excised at the shoulder, and the defect in this region is repaired The attached end of the pedicle is opened along its line of union and dissected flat to supply the external and mesial covering skin of the ear The balance of the pedicle is discarded (Fig. 319 *b*)

A piece of autogenous or preserved cartilage is properly carved to produce the general contours of the required ear and introduced between the two layers of skin (Fig. 319) The incision about the helix of the ear is closed with horsehair sutures A rectangular flap of sufficient width to produce a small tube is outlined in the hairless skin posterior to the reconstructed ear This extends from the top of the ear downward for sufficient length on the neck to produce a tube which will cover the entire helix of the ear (Fig. 319 *c d*) The superior and inferior attachments of this flap are not incised. The flap is elevated from its bed and resutured in position (delayed) A layer of gauze is placed over the ear and cotton is packed on this to approximate the skin and the carved cartilage Several layers of fluff gauze are placed on the cotton and the incised flap and a firm bandage is used for ten to twelve days The superior half of the previously incised flap is elevated from its bed, and its margins are sutured to form a pedicle (Fig. 319)

Stage 3 The interval between Stages 2 and 3 is one month

The tubed part of the flap is excised from its superior attachment. The scar line around the upper half of the helix of the ear is incised. The scar line of the upper part of the tubed pedicle is excised, and the freshened margins are slightly dissected on each side These margins of the tubed

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Stage 3 The interval between Stages 2 and 3 is one month.

The tubed part of the flap is excised from its superior attachment. The scar line around the upper half of the helix of the ear is incised. The scar line of the upper part of the tubed pedicle is excised, and the freshened margins are slightly dissected on each side. These margins of the tubed

pedicle are sutured to the freshened edges of the helix of the ear (Fig. 319 *e*) A part of the outlined rectangular flap at the inferior end of the tubed pedicle is raised and tubed. A fluff gauze dressing is applied with moderate pressure

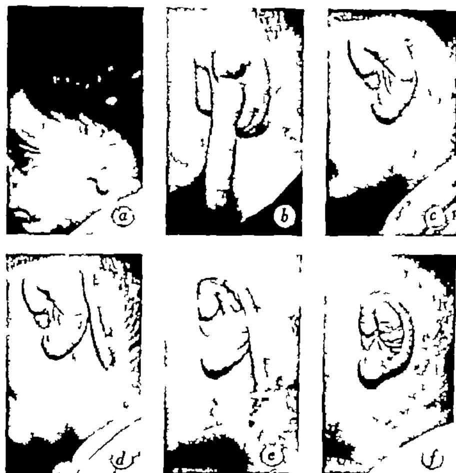


Fig. 319 *a*, Total absence of the ear excepting the lobule (congenital microtia) *b* Distal end of the tubed pedicle from the arm attached to the scalp in the region of the ear *c*, Shaped cartilage (autogenous or preserved) introduced between the two layers of the tubed pedicle a rectangular flap to produce the rolled margin of the helix *has been incised on its lateral borders, elevated, and resutured to its bed* (delayed) *d* The upper half of the rectangular flap has been tubed and the resulting defect in the scalp closed by sliding and suturing the borders. *e* The scar around the upper half of the helix has been opened, the line of union of the upper half of the tubed pedicle has been incised and its borders dissected slightly the raw edges of the tubed pedicle and those of the skin about the helix have been approximated with horsehair sutures the rectangular flap has been sutured to form a pedicle (Fig. 305) the rest of the tubed pedicle has been draped around the remainder of the helix. *f* Result.

Stage 4 There is an interval of one month between Stages 3 and 4 The remainder of the tubed pedicle is incised from its inferior attachment and draped around the remainder of the helix, as has been described.

This *procedure is not one of choice* but may become one of necessity in the event of destruction of the hairless skin about the ear Arm skin would not be used, however The required amount of more desirable skin may be obtained by use of a tube pedicle flap advanced ("caterpil lared") from the supraclavicular area.

RECONSTRUCTIONS OF TOTAL EARS

Maternal Cartilage

Plans of reconstruction based upon the use of homologous maternal ear cartilage, upon carved blocks of costal cartilage or platelets of such cartilage encapsulated in a perforated mold placed under the skin of the

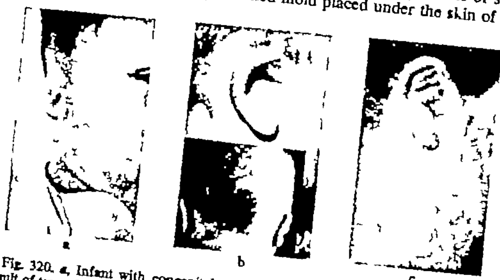


Fig. 320. *a*, Infant with congenital microtia only the lobule is present. *b* The result of transplantation of maternal ear cartilage beneath an outlined hairless temporomastoid flap subsequent reflection of this flap and cartilage forward, and grafting of the raw surfaces with split skin over a mold. *c* Appearance of the healed ear of donor after removal of the cartilage. (P W Greeley Surgery C. V Mosby Co)

abdomen for several months upon carved blocks and thin plates of cartilage utilized without any mold or shaping device other than dressings and, finally the use of finely diced cartilage molded as indicated before with several secondary operative procedures to carve the support as desired, and to accomplish size, shape and so forth—are discussed as the best present technics for producing an acceptable ear These results, in general, still leave desirable essentials to be produced routinely

Immediate transfer of homologous cartilage was made from a living donor This is a procedure described by Gillies The result pictured in Figure 320 is presented by courtesy of Dr Paul Greeley

Procedure. *Stage 1* Outline the pattern of the proposed ear on the hairless skin of the temporomastoid region at the same level as that of the existing, opposite ear Outline a Gavello flap for the lobule (Fig 320) The lobule was present in the case in Figure 320 Greeley has suggested

use of a pedicled flap from the neck to construct a lobule, but this adds scar which can be avoided. Incise the scalp to the fascia outside this outline sufficiently (3 or 4 mm.) to allow for the narrowing which occurs as the skin becomes molded to the cartilage Elevate the flap Effect complete hemostasis

Obtain the cartilage from the donor's ear Make an incision on the mesial aspect, around the helix, and carefully separate the skin and perichondrium from the cartilage *Replace the removed cartilage with a* carved piece of preserved cartilage (author) Close the skin with interrupted horsehair sutures Place a shaped gauze dressing behind the ear Place a single layer of gauze over the external surface of the ear and fill all cavities with cotton. Cover with fluffed gauze and a firm bandage The ear will retain much of its normal shape Insert the cartilage under the scalp flap of the recipient. Approximate the line of incision with interrupted horsehair sutures Apply a firm dressing as described above to be maintained until danger of collection of serum has passed (ten days)

Stage 2 The minimal period between Stages 1 and 2 is six weeks

Reopen the incision in the scalp Elevate the included flap and cartilage *as one layer Make a mold of the raw part with sterile dental modeling* compound. Cover with a single piece of split skin raw surface outward. Insert the mold (Fig. 304 *2 3*) Dress with gauze and a firm bandage and continue the dressing for seven to ten days. Remove the mold. Dry the graft in air and replace the mold and dressing. Repeat at frequent intervals, until the graft has become thoroughly organized. Complete construction of the lobule (Fig. 300)

A tragus can be constructed as pictured in Figure 302, *6* A small bit of cartilage can be used in this construction, if required.

Prosthesis. It may be desirable under certain circumstances, to replace the lost part with a prosthesis rather than to undertake a reconstruction. An excellent ear can be molded *with latex, which contains basic color* or with one of the acrylic resins. The ear can be tinted to match the surrounding skin. Construction of these prostheses is discussed on page 501

Molded Supporting Cartilage: Carved Block (Aufricht)

The author is indebted to Dr Aufricht for a personal communication containing detailed discussion of his technical procedure and excellent illustrations.

He states that, "while it is an anatomical fact that the normal ear cartilage is a thin shell with protrusions and depressions on its surface (Fig. 321 p 481) for reconstruction purposes it is more expedient to *give a different architectural interpretation The new pinna is considered,* instead, as a massive semi-circular body (Fig. 322, *b*) This shape provides a broad base and assures stability A deep concha, in our opinion is one of the most important features in creating a normal looking ear The base of the concha should be free from cartilage "

Two different methods are used to produce the cartilage block One is the acrylic mold in Figures 322, 323 and 324 which he fills with "flat

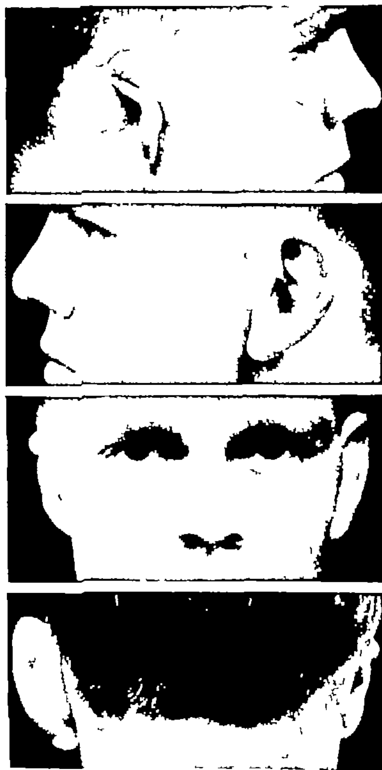


Fig. 321 Preoperative views of a patient with congenital microtia.

chips or thin platelets so that after healing it will offer a laminated structure similar to plywood." This is buried under chest skin for a minimum

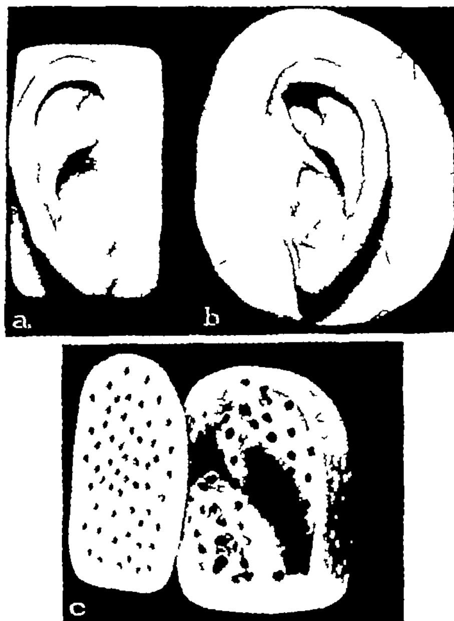


Fig. 322. *a*, Acrylic mirror model of the normal ear *b* moulage of the normal ear *c* acrylic mold of cartilage ear It is prepared from the normal ear allowing for thickness of skin and omitting the ear lobe. Perforations permit blood and serum to enter the shell to nourish the cartilage.

of six months (Fig. 324) This procedure will be discussed in detail subsequently Repair with a cartilage block follows

Procedure. *Stage I* Resect two or three costal cartilages from the sixth to the ninth ribs.

Plane the broad surfaces of the ribs to obtain good approximation with the natural curves in the direction of the planned ear

Tie the ribs in a block with stainless steel wire or silk

Plant the block under the chest and close the incision with 0000 Dermalon.

Dress with fluffed gauze and moderate pressure.

An interval of one month elapses

Stage 2 Outline a postauricular flap by accurate measurement of the acrylic model 'with the aid of a tape or thread, beginning at the tragus closely following the depth of the concha and contours of the antihelix, scapha, helix and finally the cranial surface of the ear It is advisable to

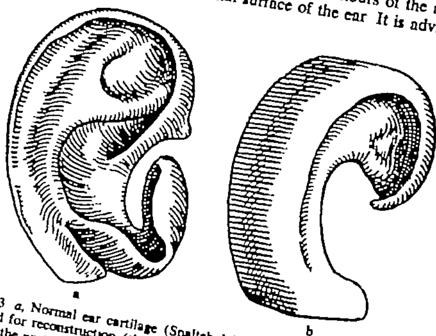


Fig. 323 *a*, Normal ear cartilage (Spalteholz) *b* diagram of the ear cartilage block used for reconstruction (three-quarter view) The thickness of the cartilage represents the protrusion of the ear and varies accordingly There is no cartilage at the base of the concha.

be generous to allow for its contracture " Incise, elevate and delay this flap Do not excise cartilage from the rudimentary ear at this time.

The congenital lobe is required in the later reconstruction (Fig. 326)

The hair in the scalp flap is ultimately removed by electrolysis

Construct a supraclavicular pencil-sized skin tube which is to be moved up the neck in caterpillar fashion (see p 16) to furnish the new helix

An interval of one month elapses

Stage 3 Elevate and delay the scalp flap

Advance the mesial end of the supraclavicular tube to the side of the neck over the sternomastoid muscle (Fig. 326)

An interval of two months elapses

Stage 4

1 Locate the new ear by careful measurement of the position of the

chips or thin platelets so that after healing it will offer a laminated structure similar to plywood." This is buried under chest skin for a minimum

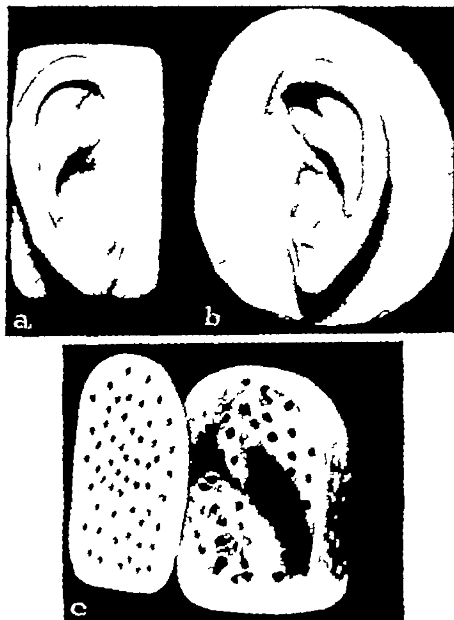


Fig. 322. *a*, Acrylic mirror model of the normal ear *b* moulage of the normal ear *c* acrylic mold of cartilage ear It is prepared from the normal ear allowing for thickness of skin and omitting the ear lobe. Perforations permit blood and serum to enter the shell to nourish the cartilage.

of six months (Fig. 324) This procedure will be discussed in detail subsequently Repair with a cartilage block follows.

Procedure *Stage 1* Resect two or three costal cartilages from the sixth to the ninth ribs

Plane the broad surfaces of the ribs to obtain good approximation with the natural curves in the direction of the planned ear

Tie the ribs in a block with stainless steel wire or silk

Plant the block under the chest and close the incision with 0000 Dermalon

Dress with fluffed gauze and moderate pressure

An interval of one month elapses

Stage 2 Outline a postauricular flap by accurate measurement of the acrylic model "with the aid of a tape or thread beginning at the tragus closely following the depth of the concha and contours of the antihelix, scapha helix and finally the cranial surface of the ear It is advisable to

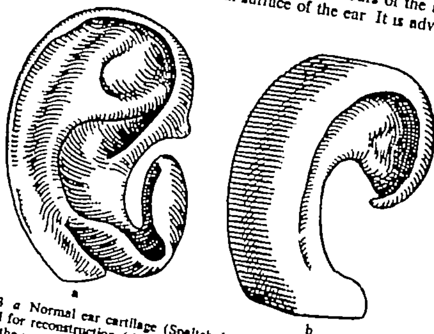


Fig. 323 *a* Normal ear cartilage (Spalteholz) *b* diagram of the ear cartilage block used for reconstruction (three-quarter view) The thickness of the cartilage represents the protrusion of the ear and varies accordingly There is no cartilage at the base of the concha.

be generous to allow for its contracture " Incise elevate and delay this flap Do not excise cartilage from the rudimentary ear at this time The congenital lobe is required in the later reconstruction (Fig. 326)

The hair in the scalp flap is ultimately removed by electrolysis

Construct a supraclavicular pencil-sized skin tube which is to be moved up the neck in caterpillar fashion (see p 16) to furnish the new helix

An interval of one month elapses

Stage 3 Elevate and delay the scalp flap

Advance the mesial end of the supraclavicular tube to the side of the neck over the sternomastoid muscle (Fig. 326)

An interval of two months elapses

Stage 4

1 Locate the new ear by careful measurement of the position of the





Fig. 324 *a*, Acrylic mold filled with cartilage chips under the skin of the chest *b* molded cartilage in shell after being buried eight and one-half months under the skin of the chest. Notice the feeding pedicles on the surface of the cartilage which grew through the perforations of the acrylic case.

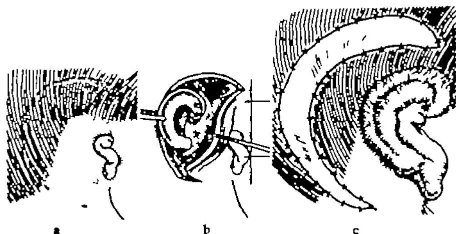
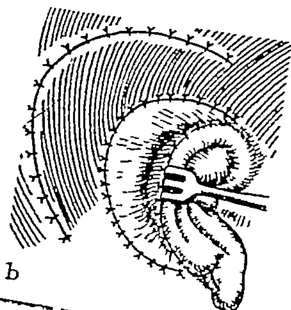


Fig. 325 *a*, Dotted line indicates postauricular flap extending into the scalp. *b* Molded ear cartilage placed under postauricular flap. *c* Molded cartilage ear in situ the gap in the scalp temporarily covered by a Thiersch graft.



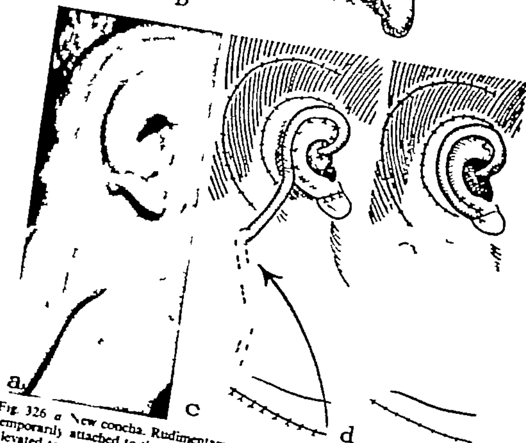


Fig. 326 *a* New concha. Rudimentary cartilage has been removed. The ear lobe is temporarily attached to the partially formed ear. The end of the clavicular tube is elevated to a new position. *b* Cranial surface of ear covered with a thick dermatome graft. The defect in the scalp caused by excision of the Thiersch graft is closed. The clavicular skin tube is partially attached to form a new helix. The cranial surface of the ear and the defect in the postauricular region are covered with a thick dermatome graft. The defect in the scalp is closed. *d* Diagram of the reconstructed ear





Fig. 324 *a* Acrylic mold filled with cartilage chips under the skin of the chest *b* molded cartilage in shell after being buried eight and one-half months under the skin of the chest. Notice the feeding pedicles on the surface of the cartilage which grew through the perforations of the acrylic case.

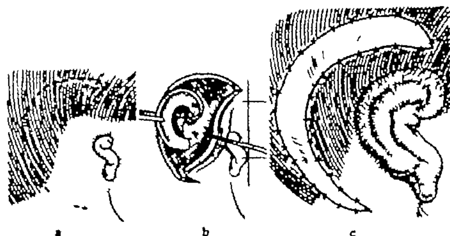
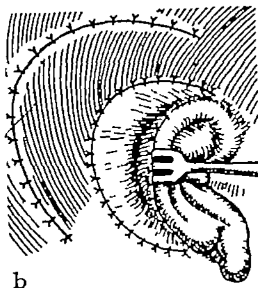


Fig. 325 *a*. Dotted line indicates postauricular flap extending into the scalp. *b* Molded ear cartilage placed under postauricular flap. *c* Molded cartilage ear in situ the gap in the scalp temporarily covered by a Thiersch graft.



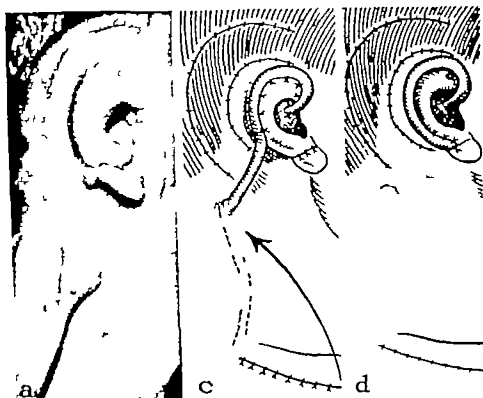


Fig. 376 *a*, New concha. Rudimentary cartilage has been removed. The ear lobe is temporarily attached to the partially formed ear. The end of the clavicular tube is elevated to a new position. *b* Cranial surface of ear covered with a thick dermatome graft. The defect in the scalp caused by excision of the Thiersch graft is closed. The clavicular skin tube is partially attached to form a new helix. The cranial surface of the ear and the defect in the postauricular region are covered with a thick dermatome graft. The defect in the scalp is closed. *d* Diagram of the reconstructed ear





Fig. 324 *a* Acrylic mold filled with cartilage chips under the skin of the chest *b* molded cartilage in shell after being buried eight and one-half months under the skin of the chest. Notice the feeding pedicles on the surface of the cartilage which grew through the perforations of the acrylic case.

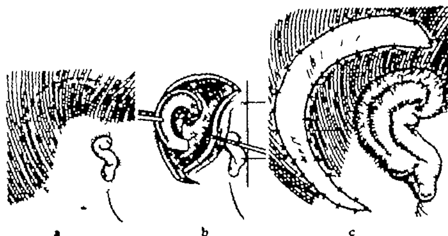
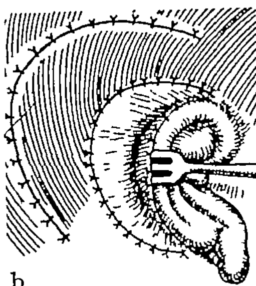


Fig. 325 *a* Dotted line indicates postauricular flap extending into the scalp. *b* Molded ear cartilage placed under postauricular flap. *c* Molded cartilage ear in situ the gap in the scalp temporarily covered by a Thiersch graft.



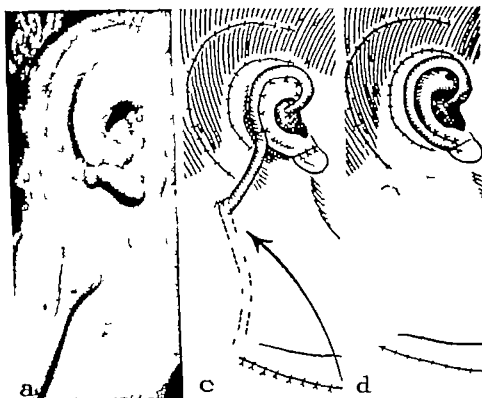


Fig. 326 *a*, New concha. Rudimentary cartilage has been removed. The ear lobe is temporarily attached to the partially formed ear The end of the clavicular tube is elevated to a new position. *b* Cranial surface of ear covered with a thick dermatome graft The defect in the scalp caused by excision of the Thiersch graft is closed The clavicular skin tube is partially attached to form a new helix. The cranial surface of the ear and the defect in the postauricular region are covered with a thick dermatome graft. The defect in the scalp is closed. *d* Diagram of the reconstructed ear

normal one and mark its outline with dye dots before shaving the hair for surgical preparation

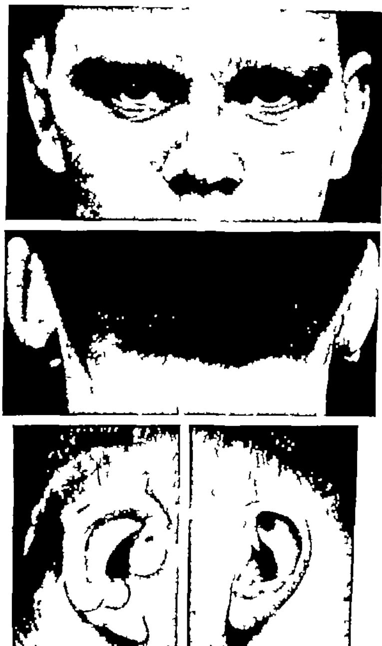


Fig. 327 Views of the reconstruction. Surgical modeling for refinement of the anterior attachment of the helix is to be effected.

2. Incise and elevate the scalp flap mesial to the rudimentary cartilages.

3 Remove the cartilage block from the chest with its fibrous capsule intact. The conchal form was formerly prepared.

4 Anchor the cartilaginous ear block in correct position with several 0000 plain catgut sutures (Fig. 325)

Drape the skin flap and cartilages in the conchal hole and over the block without any tension This will afford the greatest possible allowance for skin contraction scar formation and so forth "The circular flap may be divided by radial incisions" to permit proper draping, and so on.

The skin may be tacked in depressions with a few loosely tied, 00000 plain catgut sutures

It is now impossible to close the scalp opening by suturing. Graft this area with thin split skin (Fig. 325)

Introduce several strands of silkworm gut or narrow strips of Penrose drain beneath the scalp flap

Cover the ear surface with a piece of fine-meshed gauze pack the depressions lightly with cotton (eye pad), and cover with fluffed gauze applied with light pressure

An interval of four to six weeks elapses

Stage 5 Preparation of Final Concha. Remove the rudimentary cartilage elements and scar down to the attached cartilage base Drape the skin Split skin graft the residual defect.

Pack with tape or over a stent mold Redress in twelve days. Repeat the packing for a few weeks until organization and contraction have occurred. It is the author's opinion that packing cannot prevent such contraction, but that in this instance it will be largely evident at the base and consequently not objectionable (Fig. 326)

An interval of six weeks elapses.

Stage 6 Preparation of Pinna—Scalp Surface Mark the periphery of the ear according to the acrylic model.

Excise the scalp to the desired hair line

Excise the graft in the hairy scalp Elevate its mesial border Approximate and suture.

Split skin-graft the retro-auricular defect over a mold (Esser—see p 21)

Attach the ear lobe to the pinna.

An interval of six weeks elapses.

Stage 7 Construction of Helix Incise the scar around the helix and prepare a bed for the anterior attachment of the new helix tube

Incise the inferior attachment of the tube Excise its approximation scar and suture it in position around the ear Its attachment inferiorly to the lobule is completed after an interval of several weeks

Figure 327 presents the conclusion of these procedures. Some minor corrections remain to be completed

Diced Cartilage in an Acrylic Mold—Immediate Implant (Author)

The efforts of the group of colleagues previously mentioned to improve the end results of total ear reconstruction and the desire that the author undertake a phase of the effort occasioned much critical thinking about the entire problem. Several improvements appeared evident.

An excellent vitallium mold to contain thin plates or "diced bits" of cartilage had already been produced and utilized under the thoracic or abdominal skin. The question of covering the external surface of the en capsulated mold with thin skin to maintain its markings, carvings, de sirable skin color, and, finally its transference to the skull was proposed. This desire was evidently impractical when blood supply was carefully considered, but it became evident that the same sources of blood supply which nourish the mold transferred from the chest or abdominal walls would do the same for a properly constructed mold planted primarily under the temporal scalp and would save two or more surgical procedures It seemed certain that the external part of the mold could be removed beneath the flap of covering temporal skin the encapsulated cartilage ear form grafted with thin skin to retain its carvings the removed part of the mold replaced over the graft, and the covering temporal skin flap used as its pressure dressing.

The blood supply nourishing the encapsulated mold planted through a superior incision consists of the branches of the anterior temporal artery which supply much of the lateral surface of the normal ear' the first branch of the transverse facial, which forms a circular mesh around the annulus and tympanic membrane externally and supplies the skin of the external canal to the junction of its bony and cartilaginous parts and the posterior auricular and branches of the occipital arteries. Little of the bony and cartilaginous canal exists in a congenital microtia This vessel would supply the base of the new implant. The occipital artery would be sectioned in the event that the mold was planted through a posterior auricular scalp incision, and the parietal branch of the temporal artery would then participate in the blood supply

The mold requires a different construction from the one made of vital lium This kind of metal does not permit alteration except by swaging. Several pieces of acrylic resin were planted under abdominal skin for several months to determine the tissue tolerance This was satisfactory The external half of a perforated, acrylic resin mold of desired form was constructed like the metal one The mesial half consisted of a perforated piece representing the ear from the attachment of the concha to the margin of the helix. This permitted the base of the cartilage-filled mold to be placed on the periosteum The mold was filled with diced cartilage and the mesial exposed surface was covered with thin plates of cartilage placed at 2 mm intervals.

The mold was opened at the end of five months and the graft applied. The rods of connective tissue running from the covering skin to the en closed encapsulated mass contained *vessels* which *continued to bleed* after the mold was removed. This definitely determined adequate supply without the branches of the anterior temporal

The ear presented a perfect appearance for seven weeks, after which the sharp and curved markings began to disappear as the result of scar contraction It is the author's fixed opinion that five or more months of fibrous tissue organization surrounding the diced bits is not adequate to prevent surface contraction during the organization of a thin graft.

The removal of the mesial half of the mold at a subsequent time permits the completion of the ear with the tissue present.

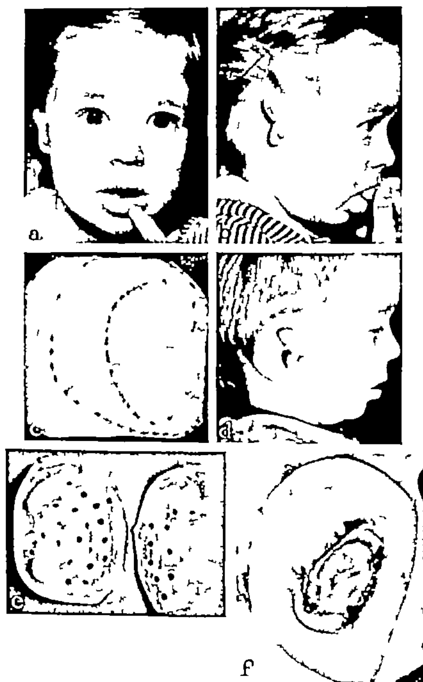


Fig. 328 *a* and *b* Congenital microtia *c* the dotted outline of the normal ear and of the available hairless skin posterior to the microtia *d* the mold containing the diced cartilage planted under the skin, *e* the two halves of the perforated acrylic mold *f* the appearance immediately after the removal of the acrylic mold.

This particular experience and a few pictures are presented with the hope that some of the readers will study the excellent procedure and the results of Peer subsequently discussed and contribute to a further refinement of technic (see Fig. 328)

Diced Cartilage—Vitallium Mold Inserted under Thoracic Skin (Peer)

Peer has devoted much thought and discussion with interested colleagues as well as a large clinical research to this challenging problem.

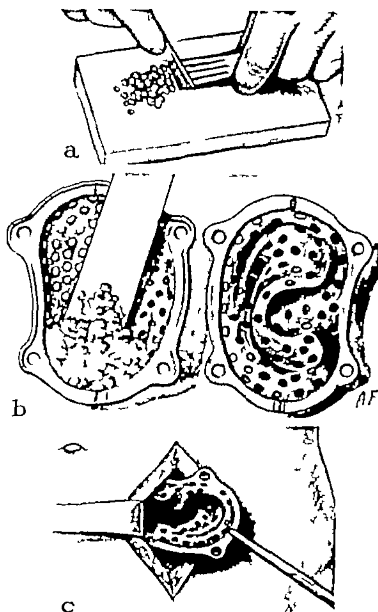


Fig. 329 Stage 1 formation of the ear framework with diced cartilage and mold. (See p 492 for detailed description.)

He has established through repeated *trial* error and meticulous *self* criticism the best results with this particular procedure These technical facts lay the foundation for the further effort of all of us to contribute to a sound technic which will routinely produce the desired result. It is the author s conviction that we will cease to implant the mold under

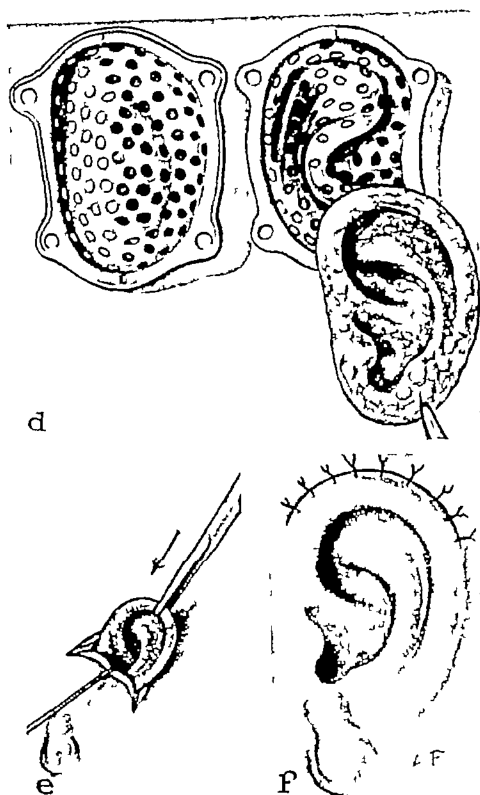


Fig. 329 (continued) Stage 2 removal and transplantation of the encapsulated cartilage. (See p 492 for detailed description.)

skin at a distance but, rather will immediately plant it under the tem poral scalp in its final location. The various requirements are such that the ultimate accomplishment will continue to require a considerable time and several surgical procedures.

The author appreciates a personal communication from Peer detailing his procedure and contributing the subsequent illustrations. He states that he is "tending to get away from too much detail in a recon structed ear Outline, angle helix a deep concha, a definite tragus and normal relationship of the ear lobe appear to be the main features giving a normal appearance."

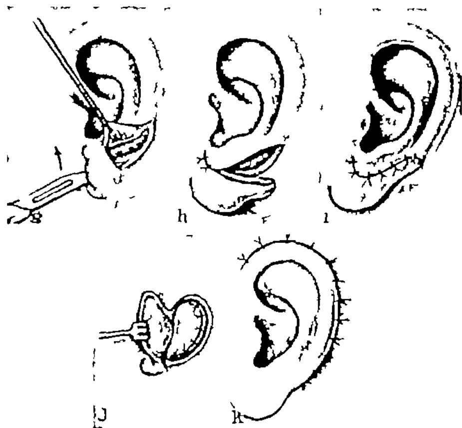


Fig. 330 *g h* and *i* Stage 3 adjustment of the ear lobe to the new ear *j* and *k* Stage 4 grafting of postauricular and scalp surfaces. (See text for detailed description.)

Procedure. *Stage 1 Formation of the Ear Framework* Remove cartilage from the seventh, eighth and ninth ribs Cut this into "diced" bits (see Fig 329 *a*)

Introduce the diced bits firmly into each half of a selected mold. If both ears are to be constructed supplement the autogenous with bits of preserved, homologous cartilage (Fig. 329 *b*)

Fasten the two halves of the mold with vitallium screws.

Insert the mold beneath abdominal skin.

An interval of five months elapses.

Stage 2 Removal and Transplantation of Encapsulated Cartilage Fibrous tissue and new vessels have grown through the perforations of the mold and about the diced bits to fasten together firmly

Remove the mold from beneath the abdominal skin and the encapsulated cartilage ear from it (see Fig. 329, *d*)

Make an incision through the temporal scalp about an inch above the superior helix of the planned ear Elevate the skin from the fascia in

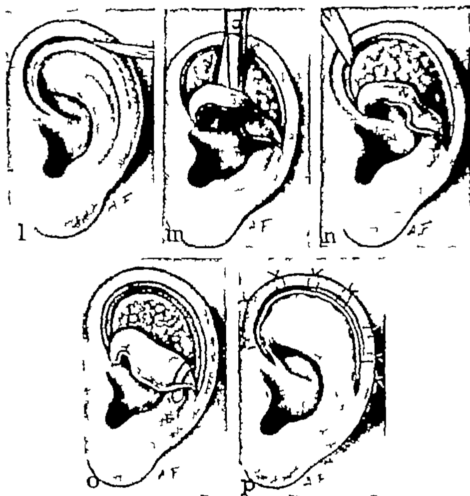


Fig. 330 (continued) Stage 5 final adjustment of helix and concha removal of hair bearing skin. (See p. 492 for detailed description.)

ferior to this incision. Do this freely enough to preclude traction on the cartilage form

Insert the form in the desired position and suture with 00000 Dermalon

Dress firmly with fluffed gauze.

Peer states that, when a canal and tympanic membrane are present, it is advisable to plant the cartilage form beneath the neck skin just above the clavicle It is ultimately skin-grafted on its mesial surface and finally transferred on a tubed pedicle The author disagrees. Such a

situation must arise from trauma or the rare case of congenital microtia. In either event, the base of the concha is either modeled to accommodate the canal or is carved before insertion of the prosthesis. This saves an added cosmetic disability—a neck scar

Stage 3 Adjustment of Ear Lobe to New Ear Incise the ear lobe as indicated. Split the skin covering of the implant.

Approximate and suture (see Fig. 330 *g h i*)

Stage 4 Grafting Posterior Auricular and Scalp Surfaces Incise the covering skin along a line 2 mm. posterior and parallel to the helix.

Dissect the cartilage framework free to the bone



Fig. 331 Cases presenting the final result of this procedure.

Make a mold of dental modeling compound (Stent) and cover this with split skin. Insert (Esser p 21) and suture (Fig 330 *j k*)

Stage 5 Final Adjustment of Helix and Concha Removal of Hair Bearing Skin. This may require more than a single procedure "The contours of the reconstructed ear will not be as distinct as is indicated by Figure 330 *l* (p 493) due to the thickness of the covering skin, the formation of fibrous tissue beneath the skin and compression of the cartilage against the rigid skull bone"

Incise the helix skin to the cartilage so as to reduce the width of the helix about one half (Fig 330 *l*)

Dissect the skin from the scapha and well into the depth of the concha (Fig. 330 *m*)

Incise deeply into the cartilage (Fig. 330 *n*) and remove enough to

reduce the width of the helix and increase its prominence It may be desirable to carry the incision to the skin graft on the mesial surface and remove a wedge-shaped strip This will allow the cartilage of the helix to roll downward in a normal manner

Remove both connective tissue and cartilage freely from the concha to accentuate the anterior and inferior crura.

Remove all cartilage from the depth of the concha.

The dissected skin flap will be larger than is required to cover the resulting defects Excise any hear-bearing skin on the borders of the flap

Pass horizontal mattress sutures from the mesial surface to draw the skin into the incised cartilage wedge The loose tying of these sutures approximates the original incision This line is not sutured (Fig. 330 p 492)

Any remaining hair bearing skin is removed later by multiple excision

Total Local Construction (Author)

This procedure in some form has been undertaken by many surgeons throughout a period of years It is useful not only in congenital defects but also in traumatic cases of several types The author utilizes in general the plan of Kirkham (see p 454) and more recently the excellent technical contributions of Aufricht (see p 480)

The author's desire and usual plan is to confine the construction to hairless skin over the mastoid, the narrow strip superiorly over the temporal squama and the narrow anterior strip between the ear attachment and the beard-bearing line in the male One need not be so limited by the female patient.

The utilization of the existing helix and the addition of skin from the anterior area are usually sufficient for the entire helix construction

The author prefers autogenous cartilage in the young child but preserved homologous cartilage is frequently used. He believes that this should be done with the parents permission and clear understanding that it may require replacement at some future time This in view of the large experience over a long period, is rather improbable

The several procedures required other than the removal of autogenous cartilage may be nicely completed under local anaesthesia. (See p 203 for this discussion)

The procedure is obviously simpler than the construction of a supporting framework in a mold and in many instances, equally satisfactory It should not, however divert the surgeon s thought and effort to further simplify and improve the mold technic

Procedure. *Stage 1* Make an acrylic model from a mirror image of the normal ear or measure the ear exactly and utilize these measurements in diagramming the new construction The adult ear varies little if any from the dimensions of the child s ear (See discussion of Brown s research on p 476)

Measure the distance from the vertex to the top of the normal ear

Mark this with dye on the defective side. Do the same from the external orbital border to the helix, center of the tragus and the opposite border of the helix. Outline the margins of the entire ear on the hairless skin if possible Exaggerate this outline to allow for covering of the conchal implant and subsequent contracture Fix the outline with puncture dots of dye. Shave the hair and prepare the field.

Incise the dotted outline.

Elevate the anterior flap to the line of the anterior temporal artery

Incise the helix to its point of attachment to the lobule

Suture the helix to the skin edges of the incised new ear border without traction (Fig. 332 *d* p 497) Approximate and suture the remaining incision with 00000 Dermalon. Dress with fluffed gauze and moderate pressure

An interval of three weeks elapses

Stage 2 Cartilage Implantation Shape a piece of cartilage for the concha and a thin plate for the pinna. Plane the approximating surfaces Fix with plain 0000 catgut.

Incise along the lower half of the posterior helix.

Elevate. Implant the cartilage to the exact desired conchal position. Suture

Outline a flap anterior to the ear for construction of the balance of the helix Its base is in the temporal hair bearing scalp and its lower attachment in the hairless skin below the lobule to produce the required, usable length. Incise the long borders of the flap Elevate and delay This tube with its base and changed position and the approximation line of its original bed is seen in Figure 332 *f*

An interval of six weeks elapses.

Stage 3 Further Preparation of Helix Tube the anterior delayed flap

Incise the entire scar outlining the helix

Elevate the skin from the lateral surface of the pinna cartilage plate for about 4 mm.

Pass horizontal mattress sutures from the scalp edge of the incision through the skin of the pinna slightly anterior to its original scar line. Tie these posteriorly and leave them in place until the new scar is well formed. This gives an added roll to the helix and prepares for its final treatment (Fig. 332 *e* p 497)

Incise the scar border of the delayed anterior flap and elevate

Elevate the skin anteriorly Approximate and suture.

Tube the flap and place interrupted 00000 Dermalon sutures

Dress

An interval of three weeks elapses

Stage 4 Transfer of Tube The circulation has been checked (see p 11 Tube Flaps)

Make an incision along the original superior helix scar from a point 1.5 cm above the helix transversely across this, and upward 2 mm. along the groove created previously with the mattress suturing. Dissect the enclosed skin a few millimeters anteriorly

Excise 1.5 cm of the approximation scar on the inferior end of the tube *Dissect a tube opening* sufficient to approximate the borders of the bed previously prepared.

Suture with 00000 Dermalon (see Fig. 332)

Dress with 30 mesh gauze strips applied with collodion (U.S.P.) to release the skin traction. Dress with fluffed gauze and moderate pressure

An interval of six weeks elapses.

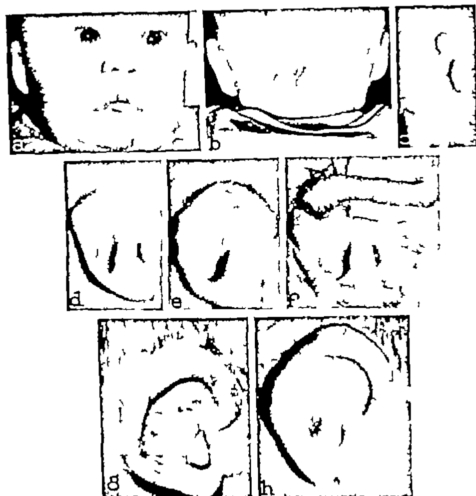


Fig. 332. Total local construction. *a*, *b* and *c* Congenital microtia, *d*, *e f g* stages in the construction *h* the final result of the procedure. (See p. 495 for detailed description of the procedure.)

Stage 5 Construction of Remainder of Helix Circulation Checked Amputate the pedicle at the edge of the hair-bearing skin on its base. Excise the approximation scar of the tube and dissect about 2 mm of the border skin

Incise the outlining scalp scar

Suture and dress

The new construction (Fig. 332 *g*) is now ready for elevation of the pinna to the conchal cartilage skin-grafting of this and the sur-

rounding raw scalp surface and the final adjustment of the helix and external covering skin

An interval of six weeks elapses.

Stage 6 Elevation of Pinna, Skingrafting of the Mesial Ear and the Raw Scalp Surfaces Incise the scar from the antihelix around the entire helix.

Separate the pinna from the periosteum to the fibrous tissue surrounding the concha.

Make a mold of modeling compound (Stent) to elevate the pinna slightly more than the desired distance from the skull. Cover this with split skin (0 016)

Elevate the bordering scalp Place the skin-covered mold. Suture with 00000 Dermalon (see Esser Inlay p 21)

Dress with fluffed gauze at moderate pressure

Remove the mold on the tenth day Dry the skin surface in the air Replace the mold and dressing. Repeat each three or four days until the graft is thoroughly organized.

The graft over the mastoid area may be removed later by multiple excision if its color is not desirable

An interval of two to three months elapses.

Stage 7 Readjustment of the Helix and External Skin Covering The size of the constructed helix is necessarily greater than the desired final Scar formation and contraction have drawn it concentrically and gravity has added to the appearance at this stage (Fig. 332 g p 497) It is now possible to thin this helix, utilize the skin around its anterior periphery to cover the pinna along the line planned and conclude the effort.

Outline with dye the desired width of the helix from the attachment of the antihelix to the lobule Allow for the contraction during the process of healing and organization Such a line will be at about the junction of the anterior with the middle third.

Incise this line down to the cartilage Remove the connective tissue between the skin layers anterior to the incision until this skin will lie flat.

Incise around the periphery of the cartilage in the pinna to the base of the skin and connective tissue on the mesial surface This should be along the junction of the helix skin and the graft on the mesial surface.

Approximate with vertical mattress sutures placed as follows Pass an atraumatic needle with 00000 Dermalon through the mesial skin surface just below the junction of the grafted and the normal skin and carry it diagonally from below through a point on the helix skin surface 1 mm from the incised margin then through a similar point on the surface of the incised anterior skin and finally out of the grafted skin near the point of beginning

Moderate traction and tying of this suture will roll the helix and invert its cut edge to approximate the inverted cut edge of the (anterior) skin covering of the pinna along the scar of the original incised outline of the ear

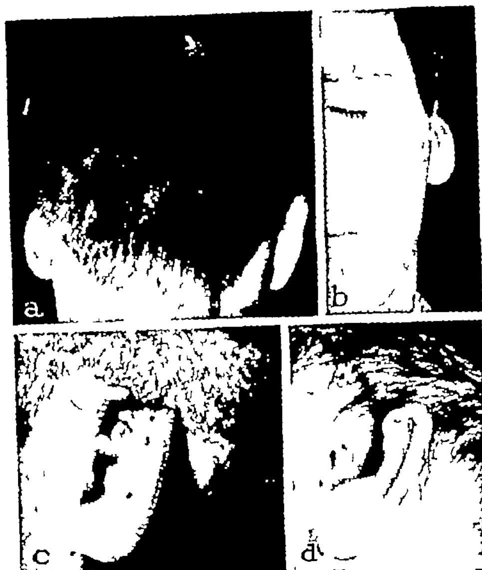


Fig. 333

Case 1. Traumatic Loss of the Superior Third of the Ear, with Adjacent Scalp and Supporting Temporal Bone. The patient was injured by a shell at Okinawa which carried away the scalp part of the temporal and parietal bones (see Fig. 333) and the upper third of the ear. The bone loss was covered by a tantalum plate. It did not cover a loss immediately superior to the ear. The ear was elevated and used to cover a dural tear. The torn helix was sutured to the rotated covering scalp flap. The healed condition is presented in Figure 333 *a b c*.

Procedure: STAGE 1. The helix and pinna were freed from the scalp and the two covering skin surfaces were sutured (Fig. 333 *d*).

STAGE 2. Outline and delay of a postauricular and cervical flap were based on the occipital scalp and required several delays (Fig. 333 *e*).

STAGE 3. Release of the scalp and ear from the dura, and rotation of the flap to cover the defect and cover the pinna. It had sufficient width to replace this loss, and was sutured to the scalp edge (Fig. 333 *f*).

STAGE 4. The helix was outlined on the scalp by incision to its corium (Fig. 333 *g*).

STAGE 5. The flap was incised along its junction with the scalp the epithelial sur













Fig. 333 (continued) Traumatic loss of the superior third of the ear with adjacent scalp and supporting bone. (See p 499 for detailed description of the loss and procedure.)

face of the scalp was removed deeply in the corium, the flap margin was sutured to the free edge of the pinna and helix, and the denuded scalp and flap were split skin-grafted over a mold (Fig. 333 *h*)

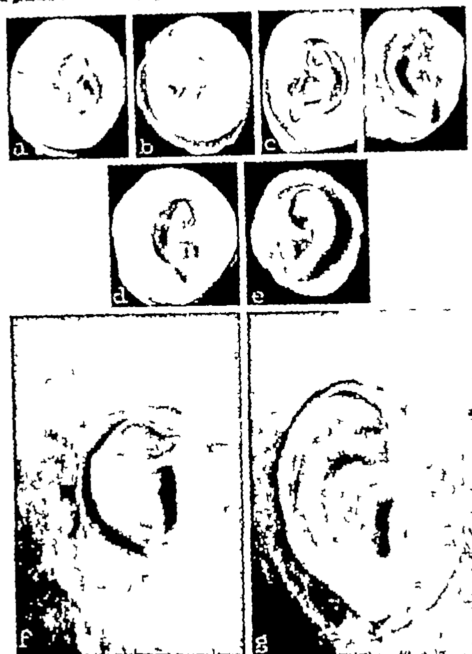


Fig. 334 *a* Prosthetic ear mold of the ear defect *b* method of obtaining a negative mold from a positive mold (*a*) *c* negative and positive molds of the prosthesis (right ear) *d* negative mold for making a latex prosthesis *e* positive mold of a prosthesis (left ear) *f* the patient's residual ear *g* the patient with the prosthetic ear applied. (Courtesy of Dr Bradford Cannon.)

STAGE 6 The hairless skin in front of the ear (Fig. 333 *f*) was rotated to construct the lost helix (Fig. 333 *i*)

STAGE 7 Construction of the anterior end of the helix and the implantation of a carved cartilage to support the new helix and pinna completed the procedure.

PROSTHESIS

The absence of the ear at any age creates of course a striking cosmetic disability This is more disturbing to men than to women but women at the present time are eager for some type of correction.

There is added to the cosmetic disability a psychic one in early youth and later manhood varying degrees of functional defect depending upon the etiology and not infrequently a mechanical, occupational disability in case of visual defects that demand the use of spectacles rather than nose glasses.

The supplying of a prosthesis postoperatively in cases of malignancy is a definite addition to the patient s progress and contentment during the months before surgical reconstruction may be undertaken. (See pp 191–501 for a discussion of the technic and so forth for the production of a desirable prosthesis.) Several plastic materials and technics are essential to them for making the desired prosthesis as well as several materials and methods of application

The author has had the privilege of seeing a burned soldier well managed by Cannon and provided with the prosthesis presented in Figure 334 *f g* The artificial ear was well made by Virginia McColl a technical assistant.

The patient was sufficiently rehabilitated by cheiloplasty and a total rhinoplasty with tissue from a distance as to become eager to return to his mechanical, civilian occupation The ears are essential to his vision and social status.



Chapter IX

RHINOPLASTY

TOTAL LOSS OF COLUMELLA

Most methods of constructing a columella contemplate the use of flaps from the surface of the lip and adjacent parts of the face with resultant increased cosmetic disability The surgeon s purpose is not only to provide the columella, but to do this in a manner that does not add to the cosmetic disability A satisfactory columella can be produced by one of four methods without any added cosmetic disability

Reconstruction with Composite Free Grafts (Ear Lobe and so forth)

The satisfactory and simple construction of the columella nasal tip and adjacent alae with free full thickness grafts taken from ear lobes was inspired by an excellent report of a considerable previous independent experience of Dupertuis with composite grafts which he made in 1946

The term "composite" is applied to these grafts as well as to grafts containing two or more tissue elements such as skin and cartilage from the pinna or helix skin and attached fat, and so on and so forth

He gives proper credit to Joseph, who reported the use of part of one ala to repair a defect in the other in 1912 to König, who reported in 1914 twenty five successful results from forty-seven applications of skin and cartilage taken from the upper ear and to Limberg who reported forty-one successes out of forty-seven cases in 1935

Brown and Cannon reported a group of cases in early 1946 in which

they utilized the technic of König and Limberg and later in the same year other cases reconstructed in the same manner They state that the procedure results in the best appearance of any method that there is a minimal deformity of donor sites and that they avoid "bulky flaps" The resulting cosmetic disability in the helix of the ear in the cases presented in both reports does not warrant the statements. It is the author's opinion again that the plastic surgeon should not create a cosmetic disability to correct another when this is avoidable (see Figs 342 343 355 356 358 359)

Dupertuis composite graft is taken from the straight edge of the ear lobe (Figs. 342 and 343 p 514) A wedge-shaped piece of the lobe

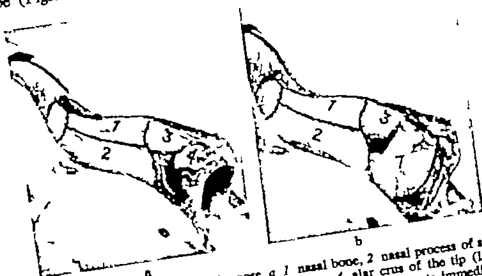


Fig. 335 Skeletal anatomy of the nose. *a* *1* nasal bone, *2* nasal process of superior maxilla *3* triangular (upper lateral) cartilage *4* alar crus of the tip (lower lateral) cartilage, the skin of the alar margin of the nostril presents immediately below this cartilage.

b *1* nasal bone *2* nasal process of the superior maxilla *3* triangular (upper lateral) cartilage *4* mesial crus of the tip cartilage *5* not shown *6* membranous septum *7* quadrilateral septal cartilage.

is resected and the defect closed by offset, laminated scar lines The resulting scar is minimal He sutures his graft under normal tension because he has observed no contraction. The author had a case in which this occurred and necessitated secondary correction

We dress these cases with a folded vertical ribbon gauze pack which is ½ inch (1 3 cm.) wide and of sufficient length to reach from the nostril floor to the desired height of the nostril The gauze is permeated with bismuth paste A strip of 30 mesh gauze is fixed externally to one ala drawn across the columella and fixed to the other ala with collodion (U S P) under sufficient tension to produce the desired moderate pressure against the inserted pads. The tip of the nose and external alae are covered with a piece of cotton eye pad fixed with gauze and collodion in a similar manner to produce the desired pressure. The dressing

is opened on the seventh or eighth day The nostril pads are replaced if they are wet. This is usually unnecessary at this time

These grafts resume their original state in due course The color and texture match is excellent They are soft and slightly flabby, however, unless some tip or new cartilage has been introduced.

The skeletal anatomy of the nose is represented in Figure 335

Reconstruction with Labial Mucosa and Split Skin Graft

Requirements. A small tube or pedicle presenting skin anteriorly and mucous membrane posteriorly, of sufficient length to replace the lost tissue

Procedure. *Stage 1* Evert the lip and make two parallel incisions down the midline, including a flap of desired width through the mucosa and subcutaneous tissue Undermine the subcutaneous tissue along a plane parallel to and about $\frac{3}{16}$ inch (about 0.5 cm) from, the surface of the mucosa This produces a flap attached at both ends (Fig. 336 *A*) Insert a thick, split skin graft beneath the flap Suture the flap and the incised edges of the mucosa with interrupted horsehair stitches (Fig. 336 *A*) Trim the excess graft and paint the stitch line with compound tincture of benzoin. Border the area with surgical glue and apply a piece of thin rubber tissue. Apply a gauze pad to the lip with a strip of adhesive tape, which is carried across the cheek on both sides to maintain firm pressure

Stage 2 Stage 2 follows Stage 1 after an interval of two weeks.

Incise the superior attachment of the flap Evert the lip and fix it in this position by a silver wire passed through a lead plate and fixed to the cheek with strips of adhesive tape (Fig. 336, *B*) Freshen the columellar stump at the nasal tip, and fix the constructed columella to it with interrupted horsehair sutures Undercut the mucosa bordering the defect in the lip and close with interrupted horsehair sutures (Fig. 336 *C*)

Stage 3 An interval of three weeks is allowed to elapse between Stages 2 and 3

Incise the base of the pedicle. Make a small, H-shaped incision in the skin of the lip at the point of columellar attachment. Free the included rectangular flaps and suture to the base of the constructed columella Close the defect in the lip (Fig. 336 *C D*)

Value of Method. The method produces a satisfactory columella without visible scar and with minimal inconvenience to the patient.

Reconstruction with Tubed Pedicle

A small, tubed pedicle can be elevated on the back of the hand, or on the body and transferred to the back of the hand for ultimate conveyance to the nasal defect (Fig. 7) Such a pedicle can be raised on the neck immediately above the margin of the clavicle and transferred to the nasal tip caterpillar-fashion (Fig 19) The first procedure is least desirable because of the texture and color of the skin as well as the nature of the procedure to accomplish it.

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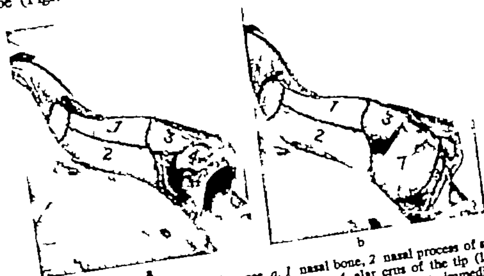


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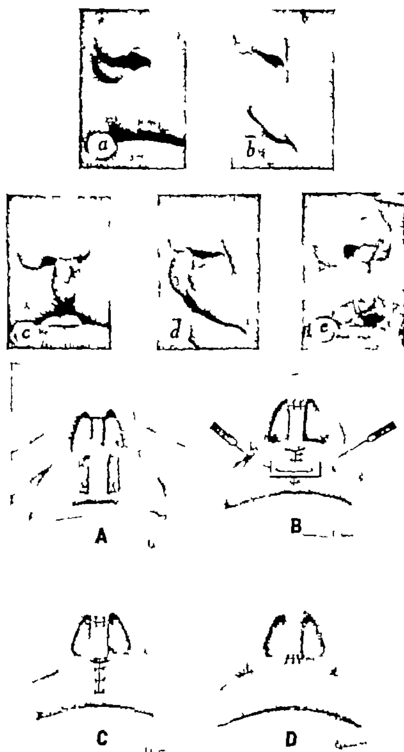


Fig. 336 Total loss of columella. *a* and *b* Appearance of patient before reconstruction. *A* Incised borders of a rectangular flap of mucosa and underlying muscle split skin graft in position. *c* *d* and *B* Superior end of mucosal flap sutured to the nasal tip lip supported by a silver wire passed through a lead plate and the substance of the lip wire fixed to cheeks with strips of adhesive tape *C* Lead plate and wire removed. *D* Inferior end of columellar flap amputated from lip and sutured in position on the lip. *e* Appearance of patient after reconstruction. (The reader should take care to distinguish between lower case and capital letters.)

SHORT COLUMELLA

Requirement. To lengthen the columella without destruction of the philtrum and, frequently, to adjust the nasal tip, the shape of the nostril and the breadth of the nostril floor or alar attachment.

It is frequently desirable and expedient to correct the malposition of the lower lateral or tip cartilage at the time of lengthening the columella The curved displaced junction of the lateral and median crura of this cartilage is in full view at the time of lengthening the skin of the columella, regardless of which of several methods is used The columellar incision which is shown in Figure 337 may be carried laterally about 3 mm inside the edge of the alar skin as in a corrective rhinoplasty and the

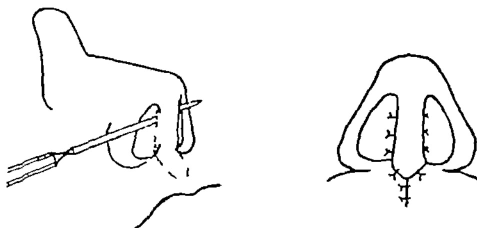


Fig. 337 Short columella, Gensoul's operation to increase the length. The dotted lines trace the course of the incision. The length of the flap on the lip is determined by the required elevation. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

cartilage and lining freed from the covering skin and readjusted in the manner discussed later

The columella may be short congenitally without any involvement of the nostril floor and lip (see Fig. 402 p 591) This presents abnormal developments of the lower lateral cartilages and frequent distortions of the tip It is usually unilaterally shortened in single cleft lips and almost universally so in bilateral clefts.

Several methods depending upon the conditions presented, are available for the correction The rolled skin edge of the nostril may be congenitally short, producing a round nostril and masking or shielding a normal length and shape of nostril posterior to it. This short edge is similar to the congenitally short helix ear skin which produces a type of lop ear with cartilage malformation (see Fig. 313 p 469) The same condition produces the congenital stricture deep in the nostril These various congenital conditions are well corrected by the same procedure

Reconstruction from Bordering Nasal Tissue. Follow the technic for reconstruction of the nasal tip described on page 528 (see also Fig. 359) Allowance is made in designing the reflected nasal flap for a sufficient length to construct the columella.

Short Columella and Alar Abnormalities

Method I Gensoul's Operation

This produces a desirable result in cases where the philtrum is of sufficient width to obtain adequate covering skin between parallel incisions inside the lateral folds of the philtrum The philtrum is the outstanding cosmetic feature of the lip and should not be destroyed.

A tight upper lip produced by closure of the lip defect can be prevented by making an incision in the alar sulcus and carrying it around the *lateral* alar attachment for 2 or 3 mm The lip skin is freely elevated from the fascia beyond the lip The elasticity of this skin permits free closure with its traction on the cheek rather than the lip Simple sutures passed through the top of the corium invert slightly the sulcus approximation and produce a scar barely discoverable

Procedure. Make the incision outlined in Figure 337 through the membranous septum from the junction of the tip cartilage to the floor Curve this anteriorly across the columellar skin junction with the lip and downward along the mesial borders of the lateral folds of the philtrum for the required distance to slightly overelevate the nasal tip (see Fig. 402, *a b c* p 591)

Carry this incision laterally for ⅜ inch (1 cm.) along a line about 3 mm. posterior to the nostril margin if correction of the nostril and alar shape is required. Separate the covering skin from the cartilage and lining up to the pyriform bony margin

Elevate the lip and columellar skin to the nasal tip

If a round nostril, a flat or buckled ala needs correction do one or more of the four things as indicated.

(*a*) Roll and elevate the lining skin and cartilage mesially until the curved junction of the mesial and lateral crura may be approximated at a proper level to the opposite cartilage with a plain 0000 catgut mattress suture This produces the desired shape. The properly dressed covering skin readily adjusts to this foundation.

(*b*) If the curved junction of the crura occurs sufficiently low down and is of such shape as to prevent rolling upward as in (*a*) determine the line lateral to the junction of the crura that will permit the cartilage with its lining to be rolled upward to the proper height, incise the cartilage and lining along this line with scissors, roll the mesial crus up to approximate the opposite cartilage as in (*a*) and approximate the lining and lateral crus with proper dressing.

(*c*) If the lateral crus is buckled in the ala, or becomes so when the nostril shape is changed, remove a millimeter strip of cartilage from the full width of the apex of the buckle or fold or make one or more vertical incisions ("lobster tail") through the cartilage. Proceed as before.

(*d*) If the alar attachment is abnormally wide—the base of the nostril too wide and the attachment of the terminal margin of the ala too far lateral from the columella—correct as follows

Mark the proper point of alar attachment to the columellar skin with a line of dye Continue this line posteriorly in a crescent form on the floor of the nostril Mark on the nostril floor the other line of an ellipse

which will include the desired contraction of the nostril base Excise the enclosed skin

Elevate the alar attachment to the maxillary periosteum as high as the pyriform border and laterally beyond the alar border Split the soft edges of both incised tissues with a horizontal incision just beneath the skin.

Approximate with horizontal mattress sutures loosely tied. This will increase the approximating raw surfaces and result in a desirable floor of proper thickness.

Approximate the skin along the membranous septum and lip with 00000 Dermalon

Dress the nostrils with bismuth paste, gauze packs and external dressings as described under columellar construction on page 504 These should be maintained for five or six days

Hair may grow on the elevated philtrum skin but this is not probable, because this skin belongs on the columella. The author has had one instance in numerous cases

Method II Vertical Incision Skin-Cartilage Separation and Elevation

This plan of correction has the same purpose in the unilateral congenital and well-operated cleft lip cases as the previously described modified Gensoul procedure The columellar incision is carried down the membranous septum and around the floor to the lateral alar attachment. Its upper end is carried laterally through the lining skin and junction of the cartilage crura about 3 mm above the nostril margin It may be continued to meet the incision in the nostril floor if this is indicated. The separation of the covering skin the columellar skin and median crus of the tip cartilage from its opposing fellow, and the elevation of the alar attachment above the maxillary periosteum, permit free rotation, elevation and all desired adjustments in the lobule, tip and nostril shape

Gillies and Kilner described and illustrated a certainly effective procedure to correct these same etiological factors Their incision is made through the skin of the tip around the junction of the two cartilage crura and down the midline of the columella to the lip It adds an unnecessary cosmetic disability in the correction of another

The procedure has been described in Method I (Gensoul) and does merit repetition.

Method III Z Plastic on Lateral Columellar Skin

This is particularly applicable to a unilateral shortness of the columellar skin in one nostril but may be applied to both sides Other methods are better for the latter however

The procedure is useful and simple for short elevation (¼ inch—0 7 cm.) only if normal skin is to cover the visible part of the columella.

Procedure. The central member of the Z is incised in the midvertical line between the lateral margin of the columella and the mucocutaneous septal line. The arms of the Z are incised at angles of about 10 degrees.

The flaps and border tissue are freely elevated in the usual manner and the flap transposed (see Z Plastic p 221)

Method IV Z Plastic Lengthening of a Congenitally Short Nostril Circumference

This procedure is discussed here because it has been well described and illustrated as a new method of elongation of the columella.

The cosmetic disability results from a congenital shortness of the nostril circumference comparable to the short helix skin which produces a type of lop ear (see Fig 313 p 469) and maldevelopment of the pinna cartilage, to the congenital stricture deep in the nostril, and so on



Fig. 338 Atresia of the left nostril, corrected by a Z plastic in a single procedure. *a* and *c* The original disability· *b* and *d* the result of the procedure.

and so forth. The rolled edge of the alar skin joins the columellar skin lower than the normal—it is a skin curtain masking lower lateral cartilages and a nostril of practically normal height and contour The columella is of normal height and does not need elongation

Straith has recently excellently described the application of the Z plastic procedure to this congenital cosmetic disability It is the *ideal manner of correcting annular strictures anywhere* (see Fig. 338 also Figs 306 307 p 461)

Atresia of the nostril, either congenital or acquired is simply and perfectly corrected with a Z plastic in a single procedure This is much superior to anything accomplished by scar excision split skin-grafting over a prosthesis and a long period of dressing (see Fig. 338 see also description of this procedure by Dr Steffensen p 462)

LOSS OF FLOOR OF VESTIBULE

This repetition of the preceding is made to emphasize its simplicity

Procedure to Construct Floor Determine and mark on the base of the columella the point of alar attachment. Mark a similar point on the ala. Excise the scar to the periosteum of the floor Free the ala and its borders from the maxilla. Split the edges of the alar defect along the midline. Pass two vertical mattress sutures of silk to evert this split tissue and increase the thickness of the new floor Approximate the skin with interrupted horsehair sutures (Fig 339)

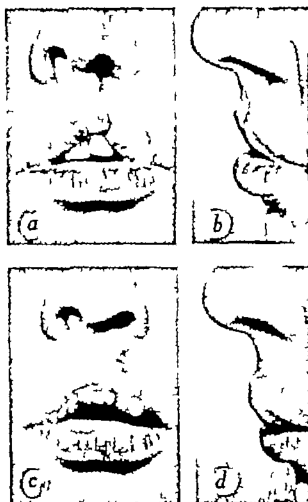


Fig. 339 Loss of floor of the nostril. *a* and *b* Appearance before operation note nasal floor and ala and condition of lip. *c* and *d* Appearance six months after correction.

LOSS OF ALA: SKIN CARTILAGE, AND LINING

In the case presented in Figure 340 *b* the loss was of the covering skin portions, of the cartilage support, and lining and soft tissues to the pyriform bone border

Requirements. Lining and skin for covering.

Procedure *Stage I* Outline on the adjacent cheek a skin flap of proper dimensions to replace the lining defect and provide a rolled edge for the

The flaps and border tissue are freely elevated in the usual manner and the flap transposed (see Z Plastic, p 221)

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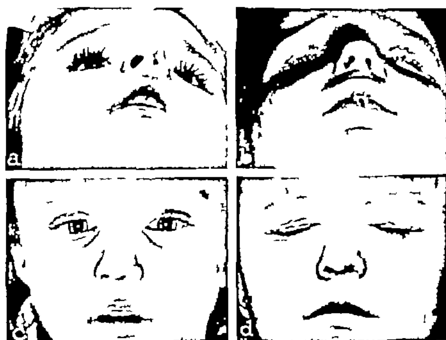


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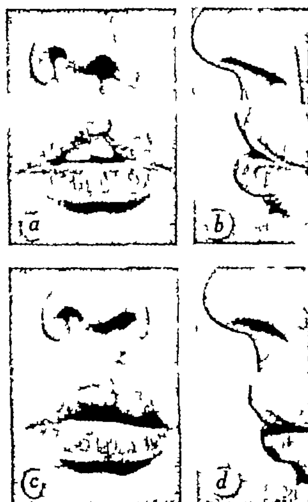


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LOSS OF ALA: SKIN CARTILAGE, AND LINING

In the case presented in Figure 340 *b* the loss was of the covering skin portions, of the cartilage support and lining and soft tissues to the pyriform bone border

Requirements. Lining and skin for covering.

Procedure. *Stage I* Outline on the adjacent cheek a skin flap of proper dimensions to replace the lining defect and provide a rolled edge for the

nostril. The base or hinge on which this flap will depend for blood supply is the tissue bordering the defect (Fig 340 *c* *A*) Incise the borders of the flap and dissect it free, as far as possible without endangering its blood supply Return the flap to its bed and approximate with interrupted

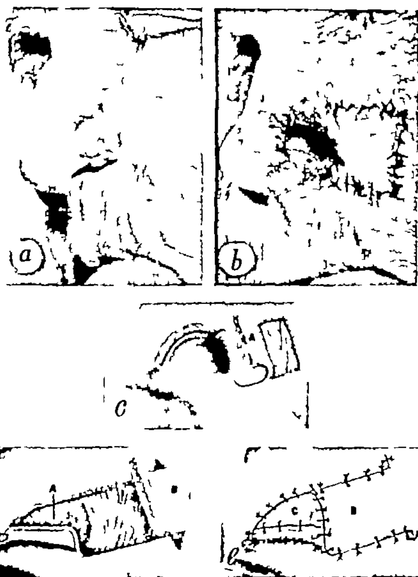


Fig. 340 Alar loss. *a* Appearance after reconstruction *b* former appearance *c* hinged flap to form nasal lining and rolled alar edge, *A* *d* lining flap and alar border in position, *A* covering flap, *B* dissected, *e* covering flap, *B* sutured in position free graft, *C* filling the alar skin defect.

horsehair sutures Repeat this delaying process until the blood supply remains adequate then rotate the flap into the defect and fold the inferior border to produce a curved edge or cuff (Fig. 340 *d* *A*)

Stage 2 Incise the skin from the mucosal lining around the margins of the defect, except at the base of the flap Suture the margins of the flap to the nasal lining with interrupted horsehair sutures passed from

within outward and tied intranasally Reflect the skin to form a rolled edge for the nostril and suture the reflected edge to the nasal skin at the tip (Fig 340 *d A*)

Outline and elevate on the cheek a sliding flap of sufficient length to close the defect in the cheek up to the nasofacial groove (340, *d B*) Slide the flap into position and approximate with interrupted horsehair sutures (Fig. 340 *e B*) Repair the remaining cutaneous defect on the ala with a full thickness graft removed from the posterior surface of the ear (Fig. 340, *e C*) (See also Skin Grafting, p 19)

Pack the nostril smoothly with iodoform gauze ribbon Cover the repaired area with a layer of gauze impregnated with Furacin ointment or petrolatum. Add several layers of gauze a piece of moist synthetic sponge about ½ inch (about 1 3 cm) thick and a cotton eye pad that

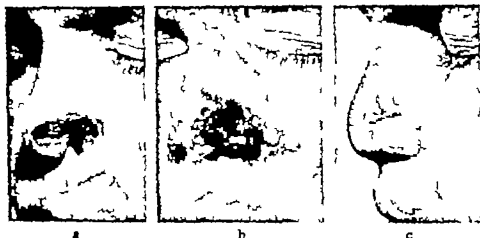


Fig. 341 *a* Loss of total alar substance and skin on nasal tip *b* appearance of covering graft immediately after removal of pressure dressing (twelve days) *c* appearance six months later A secondary correction of the bordering scar would produce the desired result.

covers the entire nose Apply a copper nasal splint and fix this to the cheeks with a strip of adhesive tape (Fig. 89) This dressing is not disturbed until the tenth or twelfth postoperative day in the case of a full thickness graft until the seventh or eighth day in case a thick, split skin graft has been used. This may have the disadvantage of producing stitch scars if the stitches are tied tightly

Result. The end result of such a procedure is pictured in Figure 340 *a*. The fulness resulting from folding or "hinging" the lining flap is noted on the edges of the nostril. This can be corrected secondarily

DEFECT OF ALA AND COVERING SKIN

In the case presented in Figure 341 the loss was of the following alar margin full thickness of alar substance and skin of the tip and side of the nose

Requirements. Skin lining and skin covering.

Procedure. This is the same as in the preceding operation This case is exhibited to demonstrate the appearance of the graft at the time of re-

moval of the splint and dressings, as well as the corrective procedures to remove the fulness resulting from hinging the lining flap

The overlapping scar on the lip has been excised and the skin approximated. The defect resulting from elevation of the lining flap was closed in this instance by sliding the surrounding skin. This scar creates an added cosmetic disability of a minor degree



Fig. 342. Congenital defect of a right ala composite ear lobe graft. (For detail and procedure, see text.)



Fig. 343 Traumatic alar loss composite ear lobe graft.

COMPOSITE EAR LOBE GRAFT

The condition presented in Figures 342 and 343 is a congenital developmental anomaly The mesial half of the right ala has not developed and the lateral existing half is rotated upward and outward The lateral crus of the lower lateral cartilage is underdeveloped.

Procedure Incise the skin along the rolled margin of the defect from the tip to the ala. Continue the incision around the superior border of

the ala 3 or 4 mm Separate the covering and lining layers for 2 or 3 mm

Elevate the covering skin over and lateral to the lobule until its mesial end can be rotated downward and inward

Excise the indicated, wedge-shaped section of an ear lobe and suture in the nasal defect with 00000 Dermalon The dressing and so forth is discussed on page 504



Fig. 344 Melanoma. *a* The initial lesion *b* wide excision of the lesion and preparation of the skin covering flap to be reflected to provide lining and the rolled alar margin *c* and *d* the result after reflection of the prepared skin flap and the closure of the nasal defect by undermining and sliding the covering skin on the lateral surface of the nose and the adjacent cheek. (See p 516 for detail of the procedure.)

TOTAL LOSS OF ALA

It is desirable whenever possible to confine the entire repair to the limits of the nose rather than to create further disabilities by obtaining either lining or covering tissues from the borders or from a distance The procedure described in this instance is available to produce a most satisfactory result for both small and moderately large defects

Loss. Skin covering, lining, and cartilages of the ala. The lining has been carefully approximated to the skin to provide adequate blood supply through a hinge or base of reflected lining flap (Figs 344, 345)

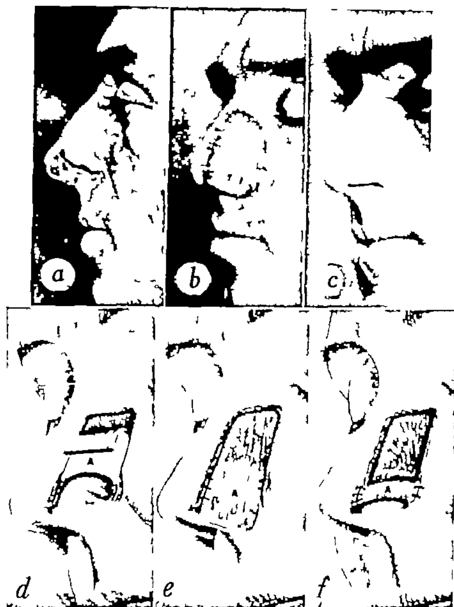


Fig. 345 Total alar loss. *a*, Condition after the loss nasal covering skin sutured to lining of mucous membrane. *d* Hinged lining flap, *A* dissecting from lateral surface of nose. *e* Lining flap, *A* sutured to nasal lining. *f* Lining flap *A* folded on itself and sutured to the skin bordering the defect to form the alar margin. *b* Wolfe graft from mesial surface of ear to replace loss of nasal skin. *c* Appearance six months after operation.

Requirements. Skin covering, lining and, in some cases, a thin cartilage support.

Procedure. *Stage 1* Outline a flap of sufficient proportions to supply the loss of lining and a cuff or rolled edge for the margin of the nostril on the lateral surface of the nose (Fig. 345 *d A*) The base of this

flap and its blood supply are formed by the union of the lining and skin at the upper margin of the defect. Incise and dissect this flap as freely as possible without damaging its blood supply Return the flap to its base and approximate its edges with interrupted horsehair sutures Repeat this delaying process at intervals of two weeks until the flap has an adequate blood supply when it is reflected and its edges are rolled to form the cuff.

Stage 2 Split the skin from the lining on the mesial and lateral borders of the defect (Fig. 345 *d*) Elevate the flap reflect it and suture its borders to the nasal mucosa with interrupted horsehair sutures passed from within outward and tied intranasally This leaves a projection of the flap which can be folded on itself to form the rolled edge of the nostril. The flap should be so folded and approximated to the skin covering that allowance is made for subsequent contraction (Fig. 345, *e f A*) Approximate the margins of the folded edge to the bordering skin with interrupted horsehair sutures (Fig. 345 *f*)

Repair the remaining skin defect with a full thickness flap taken from the mesial surface of the ear Approximate the graft with interrupted horsehair sutures tied lightly (Fig 345 *b*) This defect may be repaired with a piece of thick intermediate graft taken elsewhere on the body but the resulting color is not so satisfactory as the full thickness graft from the ear

Pack the nostril smoothly with iodoform gauze ribbon. Cover the repaired area with a layer of gauze impregnated with scarlet red ointment. Add several layers of gauze a piece of moist synthetic sponge about ½ inch (about 1 3 cm) thick, and a cotton eye pad that covers the entire nose Apply a copper nasal splint and fix this to the cheeks with a strip of adhesive tape (Fig. 89)

Figure 346 presents a case similar to that of Figure 345

Small defects resulting from the removal of flaps from the back of the ear can be corrected by undercutting and sliding the surrounding skin. Larger defects must be repaired by a thick intermediate or full thickness graft removed from some other body surface (arm thigh, abdomen and so on) Such a graft is applied and dressed as already described (p 19)

RECONSTRUCTION OF LATERAL NASAL WALL

Many of the large defects of the nose resulting from full thickness (covering skin—supporting structure and lining) loss demand tissue from a distance for reconstruction It has long been appreciated that the hairless frontal scalp provides the only nasal skin covering which consistently has the texture and the matching color desired Its initial and continued use for total rhinoplasty the ease of its transference with an assured blood supply and the simple manner of repairing the created frontal defect have not only continued its universal use on the nose but in several other constructions about the face and on the lips Its texture and color excuse neither its use here nor the created, prominent cosmetic disability in obtaining it. The grafted repair of large areas of frontal scalp can rarely

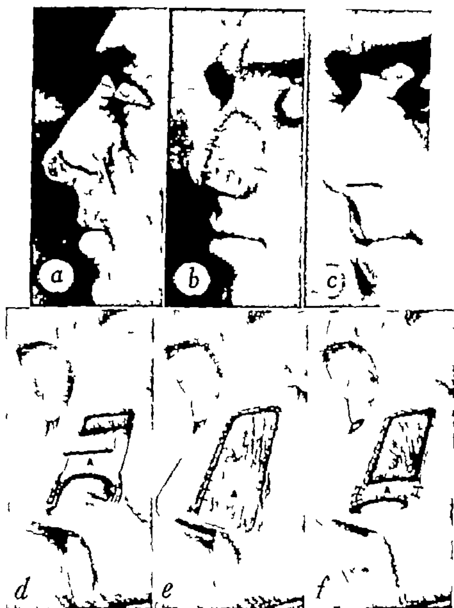


Fig. 345 Total alar loss. *a* Condition after the loss nasal covering skin sutured to lining of mucous membrane. *d* Hinged lining flap *A* dissecting from lateral surface of nose. *e* Lining flap *A* sutured to nasal lining. *f* Lining flap, *A* folded on itself and sutured to the skin bordering the defect to form the alar margin. *b* Wolfe graft from mesial surface of ear to replace loss of nasal skin. *c* Appearance six months after operation.

Requirements. Skin covering lining and, in some cases, a thin cartilage support.

Procedure. *Stage 1* Outline a flap of sufficient proportions to supply the loss of lining and a cuff or rolled edge for the margin of the nostril on the lateral surface of the nose (Fig. 345 *d A*) The base of this

flap and its blood supply are formed by the union of the lining and skin at the upper margin of the defect. Incise and dissect this flap as freely as possible without damaging its blood supply Return the flap to its base and approximate its edges with interrupted horsehair sutures Repeat this delaying process at intervals of two weeks until the flap has an adequate blood supply when it is reflected and its edges are rolled to form the cuff

Stage 2 Split the skin from the lining on the mesial and lateral borders of the defect (Fig. 345 *d*) Elevate the flap reflect it, and suture its borders to the nasal mucosa with interrupted horsehair sutures passed from within outward and tied intranasally This leaves a projection of the flap which can be folded on itself to form the rolled edge of the nostril. The flap should be so folded and approximated to the skin covering that allowance is made for subsequent contraction (Fig. 345 *e f A*) Approximate the margins of the folded edge to the bordering skin with interrupted horsehair sutures (Fig. 345 *f*)

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be replaced entirely and then only by repeated, difficult surgical effort (Fig. 184 p 273)

Several surgeons about the world have presented plans for avoiding, to a large degree this cosmetic destruction of the prominent frontal scalp in cases where there is a choice of procedure

The case presented in Figure 347 (p 519) was the author's effort twenty-five years ago to hide the pedicle scars in the hairy scalp and to use the minimum required forehead scalp on its distal end below the hair line The use of the temporal artery in the flap was not new—it had been used variously for other cosmetic repairs

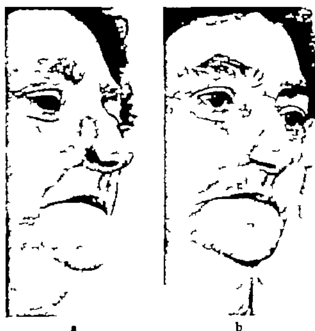


Fig. 346 Full thickness loss of the alar base. Procedure the same as that represented in Figure 345 *a*, Lining flap dissected and sutured (delayed) *b* final result of the repair

The temporal vessels may be used as the pedicle of a small forehead flap for repairs about the orbit. The flap and vessels are passed through a tunnel under the facial skin These vessels may be used similarly to transfer hair bearing scalp for an eyebrow

New has described and used with excellent results a so-called "sickle flap" taken from the temporal and parietal scalp Its distal end carries the small portion of hairless frontal scalp required for the repair The chief blood supply comes from the parietal branch of the superficial temporal artery and its collaterals It is a marked improvement on the temporal artery flap just mentioned. It is a distinct contribution to this type of reconstruction

Gillies had previously described a median so-called up-and-down sickle flap in the midline This flap receives its main blood supply from the supra-orbital terminations and so forth. It is the flap of choice for total rhinoplasty and construction of the tip and so on

The author has stated repeatedly and repeats again for emphasis that *the surgeon is never justified in making scars placing grafts or otherwise creating cosmetic disabilities in normal areas to correct another cosmetic*

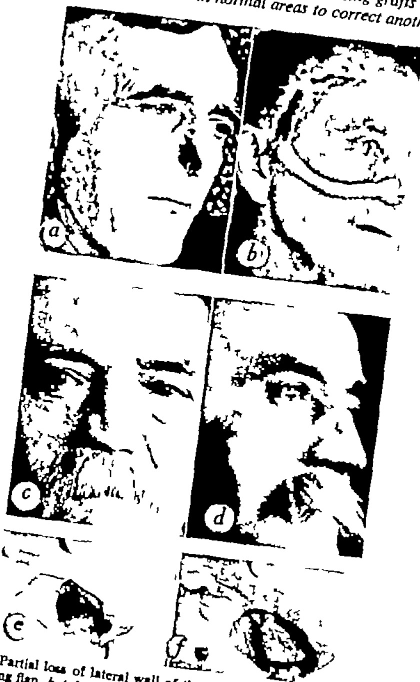


Fig. 347 *a* Partial loss of lateral wall of the nose *e* outline of lining skin flap *f* reflected lining flap *b* tubed scalp flap supplied by temporal artery *c* and *d* appearance of nose after reconstruction.

disability if he has choice of procedure This is particularly true about the face and its constituents.

The lower third and frequently the lower half of the nose—its alae tip, columella, and so forth—can be reconstructed from local tissues without the addition of any added scars in the adjacent tissues (see Figs 355 359 361 409 *a* on pp 527 531 534 602)

The total nose covering may be perfectly replaced with the full thickness skin from the mesial surface of both ears (see Fig. 368 p 545)

A large part of the total nose covering may be replaced with adjacent infra-orbital skin by multiple excision and a resultant single-line scar on the nose (see Multiple Excision, p 341, and Fig 235 p 349)

Method I. Temporal Artery Scalp Flap

Procedure. *Stage 1* Outline a rhomboidal lining flap with its base on the superolateral margin of the defect (Fig. 347 *e*) Incise, dissect and delay this flap until its blood supply is adequate (p 8) Split the covering skin from the lining along the anterior and lateral borders of the defect. Reflect the flap and suture its anterior border to the nasal lining, with interrupted catgut sutures, passed within the tissues so that the gut does not present intranasally (Fig 347 *f*) Fold the distal end of the flap to form a rolled nostril cuff (Fig. 345 *f*) Suture the mesial border of this cuff to the skin of the alar defect and the lateral border to the skin of the cheek

Dissect a flap containing the anterior branch of the temporal artery, in the hair line of the scalp This flap is so planned that its distal end is removed from a hairless area on the forehead. This portion of scalp of the forehead is of sufficient size to cover only the nasal skin defect. The flap must be sufficiently long to swing across the face without tension on its base Its edges are approximated with interrupted horsehair sutures to form a tube The flap can be utilized without delay because it contains an artery of sufficient size to guarantee its viability (Fig 347 *b*) Swing the flap and approximate the skin of its distal end to the skin bordering the defect. Dress the scalp defect with boric acid ointment gauze

Stage 2 An interval of two to three weeks is allowed to elapse between Stages 1 and 2

Amputate the pedicle from the covering flap Open it along the original suture line and return it to its source. Adjust the nasal covering flap to the skin of the face and approximate it with interrupted horsehair sutures. Remove the sutures in two days, and support the scar line with strips of gauze applied with collodion

Method II. Sickle Flap

An acceptable cosmetic repair demands skin of proper texture and color to blend with the surrounding nasal skin. This is found in the hairless frontal scalp and cannot be obtained with grafts and flaps from elsewhere in the body

A pedicle planned like the "sickle" has an adequate blood supply sufficient length for all requirements, provides the desired skin on its distal end and results in a small cosmetic disability which may be removed secondarily in most cases

The pedicle 1⅜ inch to 1½ inches (3.5 to 4 cm) wide begins in front of the ear above the zygoma It runs upward and backward to about the suture of the parietal and occipital bones (Fig. 349 p 522) then curves forward over the parietal and frontal to the hairless fore-

head just lateral to the sagittal line. The hairless skin here is sufficient for the lower half of a nose, an ala or a tip

The pedicle contains the parietal branch of the superficial temporal artery

This procedure may be adequate for total rhinoplasty, but New prefers the "up and down" type of Gillies (p 522) because this exerts no lateral pull or distortion upon contraction

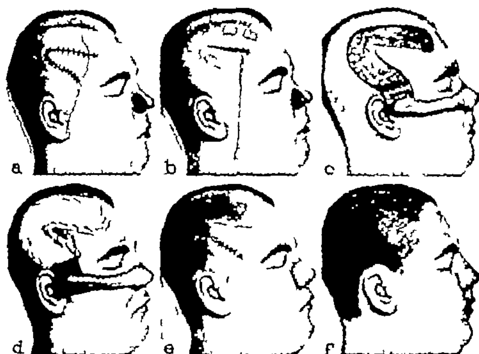


Fig. 348 Wax models demonstrating the various steps in the technical procedure. New's "sickle flap." *a*, Incision of the margins elevation and resuture of the flap delay *b* Skingrafting of the mesial distal end of the flap. *c* Elevation and transfer of the flap to the nose its pedicle is tubed by wrapping with fine parawax gauze. *e* The split skin graft of the scalp defect. *f* The section of the pedicle, excision of the skin graft except at the distal mesial end, resuture of the flap in its bed and readjustment of the nasal flap. *f* The finished condition (See Fig. 349)

The lining is provided in this technic by split skingrafting. It may be provided by a hinged skin flap from a border of the defect

Procedure. *Stage 1* Plan the correct shape and size in hairless skin Outline this area with a skin pencil below the hair line and lateral to the midline.

Shave the hair over the frontal-parietal temporal area Design and out line with dye the pedicle flap with a piece of tape to assure its adequate length Keep in mind that its lower margin determines its usable length

Incise the flap margins, except the pedicle attachments Elevate and resuture in its bed (Fig. 348, *a*) Dress

An interval of three weeks elapses.

Stage 2 Skin Graft of Distal Mesial End Incise the lateral and mesial borders of the hairless frontal skin of the mesial attachment Elevate and graft with split skin over a mold This may be a thin plate of acrylic plastic or of Stent modeling compound. Wrap the skin, raw surface out, around this

An interval of three weeks elapses

Stage 3 Incision Incise the forehead attachment of the mesial pedicle.

An interval of ten days elapses



Fig. 349 *a* The nasal loss and, *b* the result of the procedure.



Fig. 350. Midline "sickle flap" This follows the same principle as the preceding one. This patient suffered a traumatic loss of the tip of the nose and the anterior half of the ala. The midline sickle flap is preferable to a lateral sickle flap because of the fact that the latter tends to pull the reconstructed nose to one side. The transference of the flap to the nose was delayed for about three months. In this way the tissue becomes easier to fold and a better nose is obtained than if the flap is brought down immediately after its preparation, when the flap tends to be thickened and more difficult to fold. *a* The initial lesion *b* the flap returned to the scalp and its distal end replaced with original skin graft, *c* the result of the procedure (Courtesy of Dr Gordon New)

Stage 4 Test the circulation in the flap (see pp 8 11) If this is satisfactory bring the flap down to approximate the prepared defect in the nose (Fig. 348 *c*)

The open (1½ to 2 inches) flap is closed or tubed by wrapping with

fine parawax gauze Graft the raw scalp area with the split skin (Fig. 348, *d*)

Resect one half the diameter of the tube near the alar border two weeks after placing. Complete the resection one week later, open the *tube, and replace* the flap in the scalp Stretching may close the entire defect (Fig. 348, *e*)

If the flap is to be used to reconstruct the tip and columella and hence must be folded, it is better to delay its use for three or four months after preparation so that it becomes very thin and folds easily into better shape

New states that the lateral sickle flap tends to pull up to one side and is not so desirable for tip and total nose as a midline sickle which





Fig. 351 Partial alar loss (Kazanjian) Appearance of patient, *a*, before and, *b* after reconstruction *c* Incision in skin and area of dissected lining *d* Restoration of normal level of alar border' dark, shaded area represents lining defect beneath nasal process' resulting defect in skin. *e* Graft repairing defect in alar covering.

comes down from the scalp and forehead in the midline with no lateral displacement (see Fig. 350)

RECONSTRUCTION OF ALAR DEFECT

Kazanjian Method

This is an excellent procedure within limits Covering with a rotated flap from the nasofacial groove is often preferable to a graft from the ear because of the color match (see Fig. 352)







Fig. 352. Noma. *a*, Distortion of right lip and ala and asymmetry of the cheeks. *b* Lip scar excised, cheek skin advanced to close, and angle of the mouth repositioned also outline of Z flaps permitting Kazanjian procedure on the lining and a lateral and downward shifting of the ala. *c* Second Kazanjian procedure with a rotated cheek flap

Two dermal grafts were implanted in the flap area of the right cheek. Note this deformity in *a*.

The loss in the case represented in Figure 351 was of skin lining, and margin of the supporting cartilage

Requirements. Lining, and covering skin

Procedure. Make a curved incision 2 to 3 mm above the margin of the defect (Fig. 351 c) Carry the incision through the skin *to* but not



Fig. 352 (continued) *d e* and *f* The result of these procedures.

through the mucous membrane Separate the mucous membrane from the underlying skin and beneath the nasal process of the maxilla (Fig. 351 *c*) Incise the borders of the lining flap as indicated by the dotted lines in Figure 351 *c*

This will permit lowering of the border of the defect to the normal level of the nostril (Fig 351 *d*) leaving the lining defect indicated in the shaded part of the drawing. This defect occurs beneath the nasal process and is repaired by granulation without distortion of the corrected area.

Repair the resulting defect in the skin noted in Figure 351 *d* with a full thickness graft removed from the mesial surface of the ear (Fig. 351 *e*)

Pack the nostril smoothly with iodoform gauze ribbon. Cover the region of the repair with a layer of gauze impregnated with scarlet red ointment Add several layers of gauze a piece of moist, synthetic sponge



Fig. 353 *a* Hemangioma with a radiation burn and skin atrophy remaining small areas of the nevus. *b* Excision, and rotated interpolated flap from the nasal facial groove.

about ½ inch (1 27 cm) thick, and a cotton eye pad that covers the entire nose Apply a copper nasal splint and fix this to the checks with a strip of adhesive tape (Fig. 89) Close the skin defect in the ear by undermining and approximating the skin.

COLLAPSED NASAL TIP

The condition pictured in Figure 354 *a* resulted from infection and ulceration, with loss of lining and supporting cartilage

Requirements. Skin lining and cartilage support.

Procedure. *Stage I* Incise the intranasal skin from the tip to the base of the ala along a line 2 or 3 mm. above the nasal margin Carefully dissect the skin from the underlying scar and lining. Dissect the scar from the lining. This separates the lining in a manner to permit the nostril to be restored to its normal position. Repair the lining defect with a thick split skin graft held in position by several interrupted horsehair sutures Cover this graft with a piece of gauze permeated with scarlet red ointment, and fill this part of the nose smoothly with iodoform gauze ribbon Apply a cotton eye pad and a metal splint externally (Fig. 89)

Remove the splint and dressing in six or seven days. Permit the

graft to dry in air Fill the nose with light iodoform gauze packing. Continue this until the graft has become properly organized.

Stage 2 An interval of four to six weeks intervenes between Stages 1 and 2



Fig. 354 *a*, Collapsed ala. *b* Reconstructed ala scar dissected split skin graft in the lining defect.

Reopen the original line of incision, dissect the covering skin from the lining and insert a thin strip of preserved cartilage for support.



Fig. 355 *a* and *c* Loss of nasal tip and the tip attachments to the nasal alae, *b* and *d* appearance after reconstruction.

Pack the nose smoothly with iodoform gauze. Apply a cotton eye pad and a splint to the nose for several days The end result is pictured in Figure 354 *b*

RECONSTRUCTION OF NASAL TIP

Procedure. *Stage 1* Outline a skin flap based on the borders of the defect (Fig. 355 *a*) Incise elevate and delay this flap until it has ac-

quired a blood supply sufficient to permit its reflection and folding.

Stage 2 Split the skin from the lining around the borders of the defect. Reflect the flap and suture the border of its base to the lining of the defect (Fig. 355 *b*) Fold the flap on itself so as to produce the minimum of fulness at the tip Suture the borders of the tip of the flap

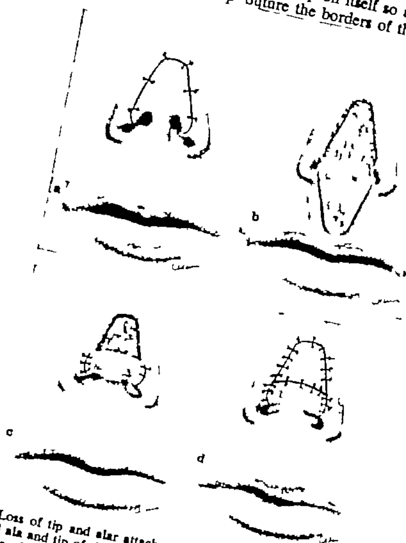


Fig. 356. Loss of tip and alar attachment. *a* Nasal skin flap to form lining of reconstructed ala and tip of the nose *b* flap reflected and sutured to the lining of the alae *c* flap folded and sutured to the skin bordering the defect of the ala to produce a redundant skin mass at the tip *d* full thickness graft filling the nasal skin defect.

to the skin covering of the defect. Approximate it with interrupted horsehair sutures (Fig 355 *c*) Repair the nasal skin defect with a full thickness graft taken from the mesial surface of the ear Approximate this with interrupted horsehair sutures tied lightly (Fig. 355 *d*)

Pack the nostril smoothly with iodoform gauze ribbon Cover the

repaired area with a layer of gauze impregnated with scarlet red ointment. Add several layers of gauze a piece of moist synthetic sponge about ½ inch (about 1 3 cm) thick, and a cotton eye pad that covers

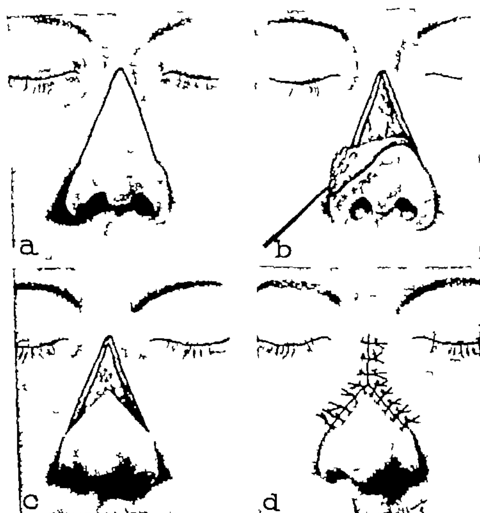


Fig. 357 Short dorsum ridge to lengthen. This requires external incision and cosmetic defect or scar (*a*) This incision is limited to the external nasal skin covering. The skin is separated from the quadrilateral cartilage (*b*) this permits separation of the lining by the Kazanjian method (see p 525) this in turn permits the desired lengthening (*c*) and suture as a Y (*d*) See Figure 84 (page 122)

the entire nose Apply a copper nasal splint and fix this to the cheeks with a strip of adhesive tape (Fig. 89)

Close the defect in the skin of the ear by undermining and approximating with interrupted horsehair sutures. The folded skin at the tip results in a knob or mound which much overcorrects the defect. This is provided to allow for subsequent organization and contraction. If the material present is in excess of the requirements it can be readjusted after a period of six or eight weeks. The results of such a repair depicted in Figures 355 and 356 *b d*

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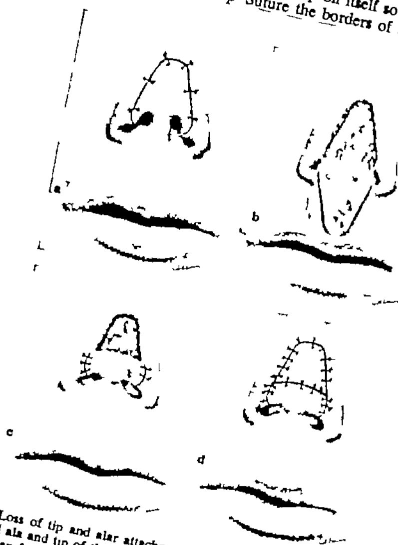


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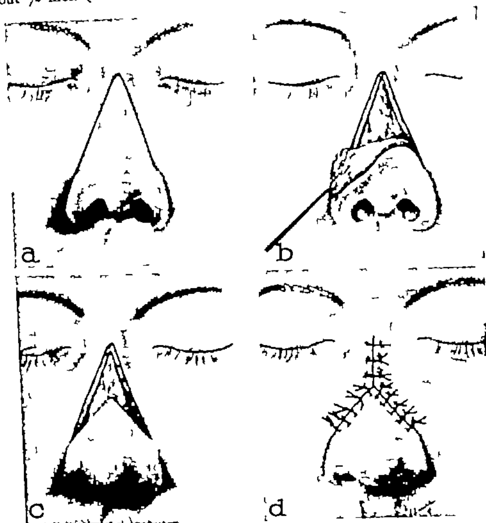


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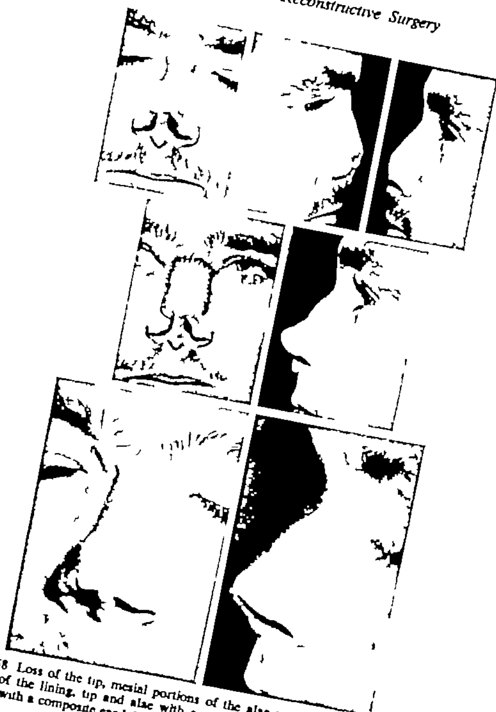


Fig. 358 Loss of the tip, mesial portions of the alae and the columella reconstruction of the lining, tip and alae with a reflected flap of dorsal skin and the columella with a composite ear lobe graft. (See pp. 514 and 527 for detailed discussion.)

A method of repair for loss of the tip and columella is represented in Figure 359

RECONSTRUCTION OF LOWER HALF OF NOSE

Reconstruction of the lower half of the nose imposes the same surgical responsibility of accomplishment without added cosmetic dis-

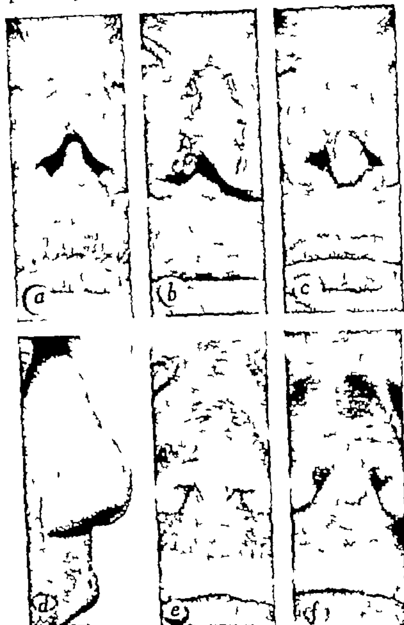


Fig. 359 *Loss of tip and columella. a* Appearance before reconstruction. *b* Nasal skin flap to form the lining of the tip and columella raised and "delayed." *c* and *d* Nasal skin flap has been grafted with skin and rotated 180 degrees to replace the tip and columella defect on the nasal ridge has been grafted with full thickness skin from the mesial surface of the ear *e* and *f* Readjustment of alar attachments photographs fifteen days after operation.

abilities as do all other endeavors in this field of surgery It is possible, in many cases, fully to discharge this responsibility

The orthodox procedure of obtaining the lining from the borders of the defect or by grafting the covering flap and of taking this flap and

its pedicle from the forehead skin permits desirable accomplishment of the reconstruction, but adds considerable of the cosmetic disabilities to the forehead to which we object. An example of such a procedure follows

The introduction of tissue from a distance is purely a procedure of necessity The numerous criticisms of the final result definitely place it in this classification The sickle flaps of Gillies and New are distinct contributions to much superior procedure The added cosmetic disability is minimal (see pp 520–522)

The author presents some cases constructed without any visible scar beyond the nose itself He feels that such procedure is the obligation of the surgeon.

Requirements. Lining and covering skin and cartilage support.

The loss in the case presented in Figure 360 was of the structures of the lower half of the nose except the base of the right ala and small part of the base of the left ala.

A better end result is obtained in most instances by amputation of alar remnants and complete reconstruction (Fig. 372) These remnants however are utilized in the reconstruction pictured in Figure 360

Case I: *Procedure* STAGE 1 Outline a skin flap with its base on the superior border of the defect, of sufficient proportions to replace the loss of lining (Fig 360 *e*) Incise dissect and delay this flap until it has acquired an adequate blood supply for its reflection. Outline incise and elevate a properly formed forehead flap for construction of the columella, nostrils and covering of the nasal cutaneous defect (Figs. 370 371) Again approximate and delay this flap for three months. This will produce sufficient thinning to permit desired folding of the columella and nostril border

An interval of four months elapses.

STAGE 2 TRANSPOSITION OF FLAPS Pare the lateral margins of the defect and split the skin from the lining tissues (Fig. 360 *f*) Elevate and reflect the flap Approximate its borders to the lining membrane with a few interrupted horsehair sutures passed from within and tied intranasally (Fig. 360 *f*) Elevate the forehead flap fold and approximate the alar margins and the columella, and approximate its lateral edges to the skin bordering the defect, using interrupted horsehair sutures Make an H-shaped incision at the site of the base of the columella dissect the small rectangular flaps resulting from this incision Approximate these flaps with interrupted horsehair sutures to the stump of the columella formed in the covering flap

Pack the nose lightly with iodoform ribbon gauze Apply a cotton eye pad and metal splint externally and fix it with strips of adhesive tape (Fig. 89) Remove the skin stitches on the second day and support the margins of the wound with strips of gauze applied with collodion Again apply the splint and continue to use it until organization has become complete

An interval of two months elapses

STAGE 3 SUPPORT OF NASAL RIDGE AND COLUMELLA Incise the skin of the columella intranasally, from tip to base Dissect a pocket in the columella and extend this in the tissues of the lip to the anterior nasal spine Dissect the covering skin from the lining along the nasal ridge and somewhat lateral to it on each side Insert a properly shaped piece

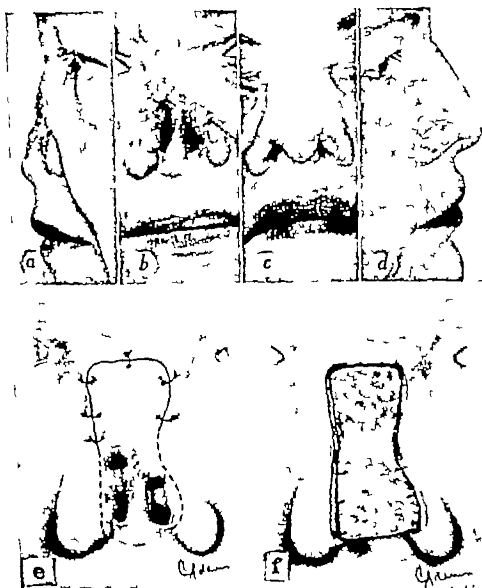


Fig. 360 Loss of lower half of nose. Appearance of patient, *a* and *b* before and, *c* and *d* one year after reconstruction *e* outline of a skin flap to replace the loss of lining *f* flap reflected and sutured to the lining bordering the defect.

of prepared cartilage into the pocket to support the ridge and a thin post of this cartilage into the columellar pocket to support the tip (Figs 373 385 409)

Close the incision with interrupted horsehair sutures Apply a cotton eye pad and a metal nasal splint with strips of adhesive tape (Fig. 89) Place light iodoform ribbon gauze dressing in the nostril. The external

splint is retained until organization has become complete. This firm splinting prevents collections of serum and blood and maintains the cartilage in position during the process of healing

Case II. This was a traumatic loss of the nose below the pyriform margin except the entire base of the right ala and a remnant of lateral left alar wall The surgeon chose to retain these



Fig. 361 Traumatic loss of the lower half of the nose: local reconstruction. (See text for detailed discussion of this procedure)

It is evident that the nose can be reconstructed locally without out side visible scar It can be covered with skin of excellent homogenous texture and a perfect color match of the bordering cheeks The visible scar will be a fine λ-shaped line on the nose

The entire procedure on a boy eleven years old was accomplished under local anesthesia

Another example is presented under Hemangioma (Fig. 409 p. 601) The planning in this case is the same in principle, but much

more difficult, in fact because of the character and distribution of available, useful tissue These cases and that in Figure 359 (p 531) presenting tip and alar construction will serve to demonstrate clearly the plan and procedure



Fig. 361 (continued)

Procedure STAGE 1 OUTLINE INCISION AND DELAY OF FLAP Outline a flap based on the margin of the defect which has the maximum length and width of the remaining nasal skin covering (Fig. 361, *a b c* p 534)

Incise as shown in Figure 361 *d* Elevate the nasal borders 0.5 cm Suture with 00000 Dermalon

Incise the left alar remnant and adjust it to the base of the flap

An interval of three weeks elapses

STAGE 2 ELEVATION AND DELAY OF FLAP Incise the border scar

Elevate the flap from its superior borders as far toward its base as possible without circulatory change The nourishment of this flap now depends largely on circulation through its fine base scar union with nasal lining Return the flap and delay

An interval of three weeks elapses

STAGE 3 Repeat Stage 2 with elevation to within 3 or 4 mm of the base scar Return and delay

An interval of three weeks elapses

STAGE 4 FLAP CIRCULATION SATISFACTORY REFLECTION OF FLAP FORMATION OF COLUMELLA AND NOSTRIL BORDERS GRAFTING OF NOSE SURFACE (Fig. 361 *e f g*) Incise and elevate the flap to within 3 or 4 mm. of its base Reflect it and note its circulation two or three minutes after folding. If satisfactory proceed.

Fold its distal end to form a tip 0.5 cm beyond normal and of adequate length (columella) to approximate the scar base on the lip Fold the remaining lateral skin to produce the nostril margins Suture with intradermal 00000 plain catgut. Suture the approximating columellar skin with interrupted 00000 Dermalon.

Make an H-shaped incision in the columellar lip scar elevate the two flaps included in the incision and suture them to the end of the new columella.

Elevate the bordering, infra-orbital skin above the fascia advance both skin layers on to the nose and fix with subdermal 00000 plain catgut sutures (Fig. 361 *e*)

Incise and remove from the mesial surface of an ear full thickness skin of a pattern covering the raw nasal surface Suture this to the reflected skin borders on the nose Split skingraft the ear (see Fig. 361 *e f g*)

The folded nostril borders are adjusted to the alar remnants at the next stage and the removal of the grafted skin by multiple excision at each border is begun The ultimate replacement of all the graft over the bony arch with normal bordering skin and a linear scar is a certainty The replacement of the final small portion on the tip between the alar folds (Fig. 361 *h i* p 535) is probable but not a certainty Hence the use of ear skin for the procedure

The following three stages of multiple excision will be indicated but not discussed in detail The procedure is obvious (see Multiple Excision pp 228 341) The adjustment of the excessive tip and columella is deferred until the multiple excision is completed and sufficient time elapses for complete organization, contraction and softening to occur

An interval of three weeks elapses

STAGE 5 MULTIPLE EXCISION OF THE GRAFT Incise the scar line along the graft and normal bordering skin Elevate the border skin above the fascia freely over the infra-orbital area. Make traction with sharp hooks to determine the amount of elevation of the grafted skin

Elevate the grafted skin as determined. Pass mattress traction sutures (see Multiple Excision p 341) Incise the approximating bor

ders, and excise Suture, incise the alar borders, and elevate and approximate them to produce the desirable tip Excise, suture and dress

STAGES 6 AND 7 Repeat Stage 5 (see the result in Fig 361, *j k l* p 535) The columella and tip remain to be adjusted The columella is incised, through its lateral, intranasal borders and the excess skin is removed to produce the desired tip columellar position and curved juncture with the lip Dress the nostrils and tip as in corrective rhinoplasty (see p 504)

The result is seen in Figure 361 *j k l* There are no visible scars external to the nose. Those present can be further improved cosmetically after a year s adjustment and softening

Case III This case, presented under Hemangioma in Figure 409 (p 601) is briefly referred to here for the sake of emphasis of the fact that the lower half of the nose and so forth may be reconstructed without the creation of added cosmetic disabilities on the forehead face, and other places. It presents a much more difficult problem than Case II because of the pathological state which requires its reconstruction and the type of the final tissue available for its final accomplishment. This however is the obligation of the plastic surgeon, which should be met whenever possible (see Fig 409 p 601)

LOSS OF FULL THICKNESS OF UPPER HALF AND MIDDLE OF NOSE

In the repair to be described a tunneled pedicle and flap containing the frontalis artery was utilized

Requirements. Covering skin and lining.

This is an adaptation of Monk s technic for reconstruction of an eyelid which in turn is a modification of a method described by Dunham The method is limited in its usefulness by the length of the frontalis artery and is applicable to the upper half or three quarters of the nose. The frontalis artery usually terminates ½ to ¾ of an inch (about 1.3 to 2 cm) above the eyebrow

Procedure. *Stage 1* Palpate the artery or locate it by measurement, and outline the required flap at its termination (Fig 362, *a*) Incise the borders of this flap, undermine it and cover its under surface with a thick, split skin graft. Approximate with interrupted horsehair sutures and cover with gauze dressing and firm bandage continue the dressing for ten days

Stage 2 Incise through the skin along the line of the artery, and flare this incision on both sides to produce a triangular rod of subcutaneous tissue including the artery and vein (Fig 362 *b* see also Fig. 284 *middle D*) Incise the borders of the flap Undermine the bridge of skin between the defect and the incision for the pedicle, the incision terminates in the glabellar region Insert bullet forceps beneath the skin grasp the margin of the flap and pull it into the defect (Fig 362, *c*) Exercise care to prevent kinking of the artery and the vein at the bend If this occurs the incision must be carried lower on the nose to expose

a greater length of artery and vein Suture the graft into the margins of the defect with interrupted horsehair sutures (Fig. 362 *d*)

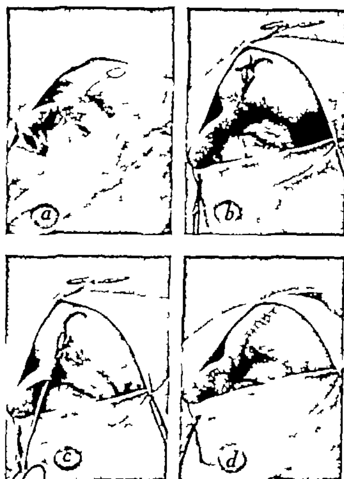


Fig. 362. Loss of full thickness of nasal wall cadaver demonstration. *a* Full thickness defect in lateral wall of nose: line of frontalis artery and outline of a scalp flap on distal end. *b* Elevation of a scalp flap and frontalis vessels. *c* Flap and vascular pedicle being drawn under the tunneled skin. *d* Completed repair (Ferris Smith Reconstructive Surgery of the Head and Neck, Thomas Nelson and Sons.)

Undercut the scalp and approximate with interrupted horsehair su tures. Remove the sutures on the second day and support the wound with gauze strips applied with collodion

SMALL, FULL THICKNESS DEFECT IN NOSE WITH DEPENDENT TIP

In the case presented in Figure 364 the position of the tip permitted removal of the bordering scar undermining of the entire covering skin approximation of the supporting and lining tissues, and ultimate read-

justment of the covering skin. This resulted not only in repair of the defect, but also in elevation of the tip which improved the original

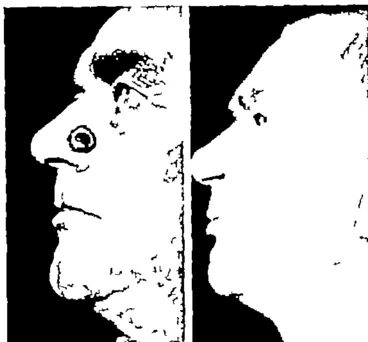


Fig. 363 Basal cell carcinoma of the lateral wall of the nose. Procedure here is identical with that presented in Figure 362.



Fig. 364 Small full thickness loss in the center of a nose with a dependent tip Repair was by excision of scar and simple suture. The result was elevation of the nasal tip. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

cosmetic appearance Such a method would not, obviously be applicable to repair of a nose with a normally elevated tip

RECONSTRUCTION FOR LARGE FULL THICKNESS DEFECT IN MIDDLE AND LOWER HALF OF NOSE

In the situation here in mind the aim would be to utilize bordering skin for lining tissue and a pedicled flap or a sickle flap (p 520) from the forehead for covering The latter is preferable

Requirements. All elements of the nasal wall including cartilage support for the nasal ridge

Procedure *Stage 1* A lining flap of proper size and proportion is outlined on the nose with its base on the superior border of the defect (Figs. 345 365 *a*) Incise dissect and delay this flap until it acquires an adequate blood supply Outline and elevate from the forehead a flap



Fig. 365 *a*, Full thickness loss of middle of nose note defect from pressure in cartilaginous septum. *b* Appearance after repair with a lining of skin from the border of the defect and a flap from the forehead for covering. *c* Final appearance after correction of the saddle with a dermal graft.

of proper proportions containing the left anterior temporal, supra-orbital and frontalis arteries (Fig. 366 *d*) Incise elevate and rotate the forehead covering flap and approximate it in the margins of the defect with interrupted horsehair sutures. The cutaneous defect now continues to the glabellar region

Pack the nose lightly with iodoform gauze ribbon. Apply a cotton eye pad and a copper splint to the nose with strips of adhesive tape (Fig 89) Dress the defect in the forehead with boric acid ointment and gauze. Remove the stitches in the skin on the second day and support with strips of gauze applied with collodion Continue the external dressing until organization has become assured

Stage 2 Amputate the pedicle of the flap and return the pedicle to its origin Undercut the surrounding scalp and approximate it by sliding. If the defect is too large for this closure it must be repaired with a full

thickness graft obtained from some other surface of the body Adjust the skin in the glabellar region and close with interrupted horsehair sutures

Stage 3 An interval of six to eight weeks is allowed to elapse between Stages 2 and 3

Incise the alar skin intranasally, along a line 2 or 3 mm above the border of the nostril from the tip to a point near the base of the ala. Separate the skin from the ridge and laterally, on each side from the lining. Insert a properly shaped piece of prepared cartilage for support of the ridge (Figs 373 385 386) Close the alar incision with interrupted stitches of horsehair and pack the nostril lightly with iodoform ribbon gauze Apply a cotton eye pad and a copper nasal splint with adhesive tape (Fig. 89) The splint is retained until satisfactory organization has occurred

Dermal graft may be utilized in place of cartilage for saddles of medium or small size (p 135) This material can be implanted on several occasions until its ultimate organization produces the desired result.

RECONSTRUCTION FOR FULL THICKNESS LOSS OF UPPER PORTION OF NOSE

Reconstruction depends obviously, upon the extent of the external and, more important, deeper damage and loss of the internal table wall of the sinus or damage to the cribriform area The discussion deals only with the external repair after such vital injury has been managed. Two cases are presented for consideration.

Case I Traumatic Loss of Covering Skin, the Superior Half of the Nasal Bones up to Their Frontal Articulation and Small Margins of the Nasal Processes. This case was operated on some years ago by the universally practiced technic The author would plan it differently in recent

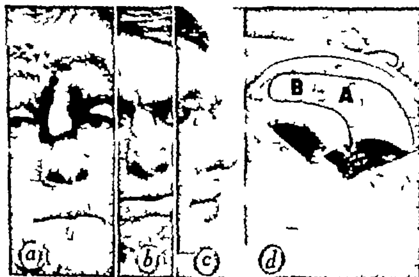


Fig. 366. Full thickness loss in glabellar region. *a* Rotated, grafted flap from forehead, *b* and *c* appearance immediately after reconstruction and healing; *d* outline, *A* of forehead flap containing frontalis and supra-orbital arteries *B* outline of portion grafted to replace nasal lining.

years All scarring of the forehead would be eliminated. The lining would be obtained by reflected, hinged flaps from the borders, the external covering by thick split skin graft, this graft replaced by multiple excision bringing in normal bordering skin and terminating with a single line scar

Requirements Lining and covering tissue

Procedure STAGE 1 Outline a flap including the supra-orbital and frontalis arteries, as pictured in Figure 366 *d A* Incise the superior and inferior borders of the flap and elevate it by blunt dissection Apply a thick, split skin graft of the desired size at its distal end (Fig. 366 *d B*) Approximate the edges of the flap with interrupted horsehair sutures Apply a firm gauze dressing for ten or twelve days.

STAGE 2 An interval of ten days to two weeks is allowed to elapse between Stages 1 and 2

Pare the margins of the defect and split the skin from the lining tissues. Elevate and rotate the forehead flap 90 degrees and approximate it to the borders of the defect with interrupted horsehair sutures (Fig. 366 *a*) Undermine the borders of the defect in the scalp and approximate with horizontal mattress sutures (Fig. 366 *a*)

STAGE 3 The interval between Stages 2 and 3 is three weeks

Amputate the pedicle and adjust it in its original bed (Fig. 366 *b c*) Adjust the amputated border of the nasal transplant.

Case II. This patient suffered laceration about the right inner canthus, loss of the superior half of the nasal bones and margins of the nasal processes, fracture of the inner table and the cribriform with fluid drainage. This discussion deals with the management after closure of the fractures, granulation, and so forth.

The plan of construction admits the use of either a carved cancellous block or finally ground bone from the ileum or of cartilage. The author chose cartilage because he wished to line the covering flap with split skin and was not certain of the fate of the bone under such circumstances. It is probable that the blood supply would be adequate and that the bone would ultimately unite with the bony borders of the defect.

Requirement Covering and lining skin and supporting tissue, either bone or cartilage (Fig. 367 *a, b* p. 543)

Procedure STAGE 1 CANTHOPLASTY OUTLINE AND INCISION OF THE COVERING FLAP IMPLANTATION OF CARTILAGE AND SKIN GRAFT OF ITS DISTAL END.

The location of the elevated canthus was marked. A tongue-shaped flap was incised base nasally of slightly greater width than the width of skin from the canthus to its new location (Fig. 367 *a*)

This flap was incised and elevated.

The incision was continued around the canthus below the margin of the lower lid. The canthus and lids were elevated from their bony attachment. The canthus and lids and the elevated flap were transposed and sutured with 00000 Dermalon. See Figure 367 *a* and note the end result in Figure 367 *c d*

The distal half of a forehead flap supplied by the temporal and supra-orbital arteries was outlined incised, and elevated.

A piece of costal cartilage was carved to the size and shape for the desired contour and support of the reconstruction, and fixed in proper position under the flap with two 00000 plain catgut sutures. This area of the flap was covered with a piece of split skin (0 016) and dressed. Figure 367 *c* presents the healed result.

An interval of six weeks elapsed.

STAGE 2. ROTATION AND INTERPOLATION OF THE FLAP The margins of the defect were pared and the skin borders elevated slightly

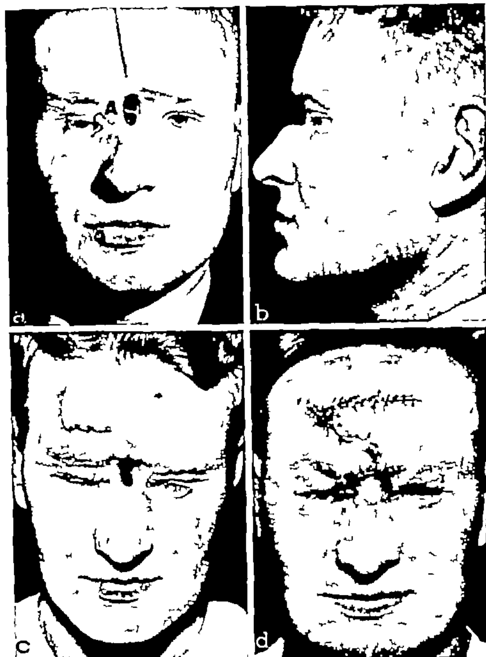


Fig. 367 Case II loss of the superior half of the nasal bones and margins of the nasal process laceration of the inner canthus. (See p. 542 for detailed description of this loss and the procedure)

The borders were incised and the flap was elevated. The borders of the distal end of the flap were trimmed to the desired shape. The excess grafted lining was removed.

The flap was rotated and its prepared distal end approximated to the borders of the defect with loosely tied horizontal mattress sutures of 00000 Dermalon. The approximating borders of the rotated flap were sutured with a few interrupted sutures.

The exposed frontal area was covered with a few layers of petrolatum or Furacin gauze. The area was covered with fluffed gauze and bandaged with light pressure.
An interval of six weeks elapsed.





Fig. 367 (continued)

STAGE 3 AMPUTATION OF FLAP ADJUSTMENT OF BORDERS OF IMPLANTED FLAP AND THE SCALP DEFECT The flap was amputated and elevated, together with the surrounding glabellar scalp and adjusted and sutured with horizontal mattress stitches loosely tied. The superior end of the implanted flap was adjusted to the glabellar scalp and sutured in a similar manner (Fig. 367 *d* p. 543)

The scalp was freely elevated about the borders of defect and lateral to its base. All scalp borders were approximated with traction and sutured with 00000 Dermalon.

The surface epithelium of the tip of the advanced scalp necrosed in this case and required excision at the time of final adjustment of the frontal scars in order to obtain the best cosmetic result (see Fig. 367 *d*)

Figure 367 *e f g* presents the result of the two reconstructions. The patient does not, as yet, desire cosmetic frontal adjustments.



Fig. 368. Destruction of nasal covering skin. *a* and *b* Scar and distortion of left ala following third degree burn *c d* and *e* appearance of nose after removal of scar and after covering with full thickness skin from mesial surfaces of the ears.

REPLACEMENT OF NASAL COVERING SKIN

The loss, in the situation contemplated here, is of the entire nasal covering following a burn

Requirement Skin of a texture and color that will match the surrounding skin. This skin can be obtained from the forehead with a pedicled flap Such a course produces considerable cosmetic disability however, which can be avoided by utilizing the entire skin from the posterior surfaces of both ears

Procedure The scarred skin is removed from the entire nose, and distortions such as that noted in the left ala in Figure 368 *b* are corrected by removal of contracted scar The skin of the entire posterior surface of both ears is removed and applied to the nasal bed, as described on pages 25 and 26 The color of this skin is usually satisfactory

The defect in the ear is repaired with thick split skin obtained from some other surface of the body The nose is covered with one or two layers of gauze impregnated with scarlet red ointment. Several layers of gauze a piece of moist, synthetic sponge about ½ inch (about 1 3 cm.) thick, and a cotton eye pad to cover the entire nose are added A copper nasal splint is applied and fixed to the cheeks with a strip of adhesive tape (Fig. 89)

SUBTOTAL LOSS OF NOSE

Figure 369 illustrates how this situation can be managed. The forehead covering flap is outlined, grafted with lining skin, and rotated and utilized in exactly the same manner as on page 542



Fig. 369 *a*, Subtotal loss of the nose and adjacent cheeks, skin-grafted forehead flap containing the temporal, supra-orbital and frontalis arteries, *b* appearance fifteen months after reconstruction.

Prosthesis A temporary prosthesis, molded from tinted latex or the acrylic resins can be provided for the patient during the period before final reconstruction This will replace the usual dressing covering the loss and add greatly to the patient s morale

Certain extensive losses of supporting bony structure and soft parts may preclude a satisfactory reconstruction A permanent prosthesis is supplied in these cases (see Maxillofacial Prosthesis p 187)

PLAN OF TOTAL NASAL COVERING

A mask of the defective face (Fig. 371) is obtained and a proper nose constructed from modeling clay This model furnishes the desired measurements for reconstruction

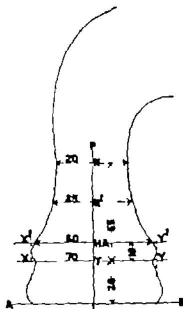


Fig. 370 Plan of a total nasal skin covering. Letters and numbers on the face of the drawing are explained in the text.



Fig. 371 Construction of a total base, cadaver demonstration. *a* Lining reflected from the borders of the defect forehead covering flap incised *b* distal end of the forehead flap folded to produce skin-lined alae and a columella *c*, forehead flap rotated and sutured in position. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Procedure Draw (Fig. 370) a horizontal line, *AB* and erect a perpendicular line, *PL* at its center This perpendicular line will be the center or ridge of the nose The point of intersection, *L* of the two lines will become the point of union between the new columella and the lip

Measure the distance from *L* to the anterior surface of the tip and mark this on the perpendicular line as *T* Draw a line, *XY* through this point, *T* parallel to the base line The included tissue will form the tip, alae and columella Measure the distance from the tip, *T* to the nasion *N* and mark this on the perpendicular line Measure the height of an ala and mark this on the perpendicular line at *HA* Draw a line, X^1Y^1, through this point parallel to the horizontal lines already plotted. Measure the distance from one alar labial groove over the tip to the opposite alar labial groove Mark this measurement on the line *XY* so that the point *T* becomes its center Erect perpendicular lines at the extremities of this measurement. Measure the width of the nose from one nasolabial groove to the other at the superior limit of the alae, X^1Y^1 at the nasion *N* and at the midpoint between, N^1 Mark these measurements, using the line *PL* as their center

Now connect these points and lay out a pedicle of proper length and shape to include the nasal, frontal and anterior temporal arteries (Fig. 370)

TOTAL RECONSTRUCTION OF NOSE

The procedure discussed here, to compensate for total loss of the nose utilizes an Indian type of flap a lining obtained from the lateral skin borders, and cartilage support for the ridge and columella (Fig 372)

Requirements. Lining tissue, supporting tissue covering skin

Procedure *Stage 1* Rotate sufficient skin from either lateral border to furnish the entire nasal lining, except that of the vestibule of the nose (ala, tip columella) Suture this with interrupted catgut (Fig. 371)

Outline a carefully planned forehead flap (Fig. 370) containing the anterior temporal, supra-orbital and frontalis arteries in its base and retaining the anterior temporal artery at its distal end (Fig. 371 *a*) Incise the pattern of this flap leaving a bridge of skin containing the temporal artery at its distal end. Elevate the flap by blunt dissection, without injury to the elements of the epicranius (occipitofrontalis) muscle and approximate its borders with interrupted horsehair sutures (Delayed Flap p 17) Dress with gauze and a firmly applied bandage Remove the sutures on the second day and support the wound with strips of gauze applied with collodion Elevate and delay this flap until its blood supply has become adequate Dress the nose (lining flaps) with petrolatum or Furacin gauze, an eye pad covering and light pressure

An interval of three weeks elapses

Stage 2 Folding of Columellar and Alar (Nostril) Margins Rotation and Approximation of the Covering Flap Approximation of the Columella Skin Graft of Scalp



Fig. 372. Total reconstruction of the nose. *a* and *b*. Loss of bony and cartilaginous support and of nasal lining; partial loss of lower half of nose. *c*. Flap from forehead rotated and formed to reconstruct the nose. *d*. Appearance six months after operation. (Ferris Smith: Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Elevate the flap and fold its distal end, after the plan of Petrall, to form the columella and the alar lining as depicted in Figure 371 *b* Tack the formed lining to the overlying skin with a few fine interrupted catgut sutures Approximate the edges of the formed columella with a few interrupted horsehair sutures. Rotate the flap 90 degrees and approximate its borders to the bordering skin of the face with interrupted horsehair sutures (Fig 371 *c*) Make an H-shaped incision in the skin at the point of attachment of the columella and undermine the small, outlined rectangular flaps Approximate these to the stump of the formed columella, with interrupted horsehair sutures.

Fill the nose with loose iodoform ribbon gauze Apply a cotton eye pad and a copper nose splint externally and fix to the cheeks with adhesive tape (Fig 89) Repair the scalp defect with a full thickness (Wolfe) graft. Apply a layer of scarlet red ointment gauze and several layers of plain gauze with a firm bandage Leave this in position for twelve days. Remove the nasal skin sutures on the second day after the day of their insertion support with strips of gauze applied with collodion and again apply the metal splint. This splint is left in position until the healing and the organization have become satisfactory

An interval of three or four weeks is allowed to elapse between Stages 2 and 3

Stage 3 Supporting Cartilage Implants Incise the skin of the columella intranasally from tip to base Dissect a pocket in the columella and extend this into the tissues of the lip to the anterior nasal spine Dissect the covering skin from the lining along the nasal ridge and somewhat lateral to it on each side Insert a properly shaped piece of prepared cartilage into the pocket to support the ridge, and a thin post of this cartilage into the columellar pocket to support the tip (Figs. 373 385 386)

Close the incision with interrupted horsehair sutures. Apply a cotton eye pad and a metal nasal splint with strips of adhesive tape (Fig. 89) Place a light iodoform ribbon gauze dressing in the nostril The external splint is retained until organization has become complete This firm splinting prevents collections of serum and blood and maintains the cartilage in position during the process of healing

SADDLE NOSE

Reconstruction for Saddle Nose

The defect, in the situation contemplated here is attributable to loss of bony support and lining (Fig 374)

Requirements. Removal of scar addition of lining and supporting tissue

Procedure. The interior of the nose must be approached through an opening which will permit complete removal of the contracted, adherent scar that produces the deformity and which will afford an *opportunity*

for replacement of the lining This opening can be made in one of several ways (1) The nasal cavity can be opened through an incision made in the buccal sulcus beneath the lip (2) It can be opened as depicted in Figure 373 a b (3) It can be opened through an incision along the nasolabial groove extending from the inferior margin of the nasal process

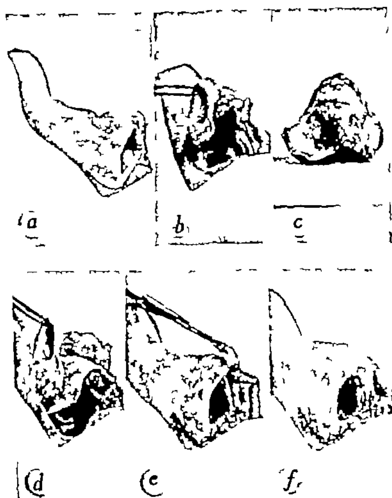


Fig. 373 Saddle nose, the result of loss of bony support and lining, cadaver demonstration *a* Condition before reconstruction outline of an incision to expose the interior of the nose· *b* contracted scar lining removed from interior of nose and borders of the glenoid fossa to release nasal soft parts *c* thick, split skin graft over a dental compound model to replace the loss of lining; *d* mold and graft in position in the nose *e* implantation of cartilage to support the nasal ridge and columella *f* appearance after reconstruction.

of the maxilla on one side, upward across the glabellar region and downward to a similar point on the opposite side In this procedure the soft parts are dissected free from the bone, and the scar is dissected from the margins of the glenoid fossa The procedure through this approach varies materially from the one to be described. It contemplates the introduction of a pedicled forehead flap to furnish the lining and the sup-

porting tissue The base of this pedicle is subsequently amputated and returned to its bed as described on page 548 This procedure adds cos metic disability to the forehead and external nose It is not a procedure of choice and is rarely necessary

Stage 1 Begin an incision in the nasolabial fold at the upper margin of the ala carry it around the ala, beneath the lower margin of the nostril and the base of the columella, then along a similar line beneath the opposite nostril, and finally along the nasolabial fold of the opposite ala (Fig. 373 *a* *b*) Dissect the lower end of the nose free (Fig. 373 *b*) and remove all the involved scar tissue



Fig. 374 Reconstruction for nasal saddle, by procedure pictured in Figure 373. Appearance in profile, *a* before and, *b* after reconstruction anterior view *c* Before and, *d* after reconstruction. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

Make a mold of plastic dental modeling compound of proper size to restore the normal shape of the lower half of the nose (Fig 373 *c*) This modeling compound is sterilized by boiling and is allowed to cool to a degree at which it will remain plastic The nasal cavity is filled with the compound, and the external nose is returned to its normal attach ment and is modeled over the compound. The compound becomes hard and is readily removed after cooling.

Cover the mold with a thick intermediate skin graft raw surface out ward, and insert it in position (Fig. 373 *c* *d*) Adjust the nasal soft parts over the mold and close the line of incision with interrupted horse hair sutures (Fig. 373 *e*) Apply a cotton eye pad and a nasal splint, using strips of adhesive tape (Fig. 89)

Stage 2 An interval of eight to twelve days is allowed to elapse be tween Stages 1 and 2

Reopen the incision and remove the mold of modeling compound.

Close the incision with interrupted horsehair sutures Place a moderately firm dressing of iodoform ribbon gauze or ribbon gauze saturated with Furacin ointment in the grafted region. Repeat this dressing daily until the skin has become thoroughly organized. Maintain the external shape and ridge by use of an eye pad dressing and a metal nasal splint (see Fig 89 p 126)

The interval between Stages 2 and 3 is six weeks

Stage 3 Incise the skin of the columella intranasally on each side and connect these incisions across the base Elevate the skin of the columella and separate the skin from the grafted lining along the ridge Continue this separation to the glabellar region and laterally on each side Insert a properly shaped cartilage to support the ridge and the tip (Fig. 373 *e*) The cartilage is carved with a beveled thin edge on the distal end of the long ridge support. This end is placed under the glabellar periosteum, which has been incised and slightly elevated. The free end of the shorter columellar support is made slightly concave to abut the nasal spine

If autogenous or live homologous cartilage is used the junction of the columellar and ridge pieces is a hinged contact made by leaving a section of perichondrium on the flat external surface of the cartilage and removing a proper V-shaped wedge from the cartilage beneath (see Figs. 385 386 p 571) If preserved homologous cartilage is used the junction is made by mortising the ridge portion and inserting a tenon on the end of the columellar piece

Approximate the skin of the columella with interrupted horsehair sutures. Apply a cotton eye pad and a copper nasal splint with strips of adhesive tape, and continue these dressings until organization has become complete (Fig. 89)

Alternate Procedure. If the interior of the nose is approached through an intra-oral incision, the mold of modeling compound can be supported on a prosthesis attached to bands or a splint on the upper teeth (Fig. 375, *a b*) The mold is removed at the end of seven to ten days and is cleaned,

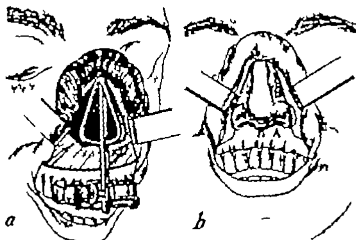


Fig. 375 Prosthetic appliances, with dental attachment to maintain nose in normal position during, and subsequent to its lining with skin graft. *a* Metal frame introduced into nose beneath lip and attached to dental caps, *b* framework covered with dental modeling compound

dried and reinserted at proper intervals until the organization of the graft has become complete and the cartilage support is to be inserted. Various types of prosthetic support can be devised and fitted in dental laboratories (Fig. 375 *c d*)

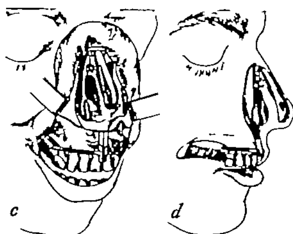


Fig. 375 (continued) *c* and *d* Appliance to maintain shape of nose during organization of skin graft and before implantation of cartilage support. (After Gillies, from Sheehan Plastic Surgery of the Nose. P B Hoeber Inc.)

Luetic Saddles. The following is a luetic case with large loss of the left nasal process and articulating margin of the nasal bone almost total loss of the septum extensive loss of lining tissue and, finally marked scar formation and contraction.

The ultimate ridge support differs from the preceding case

Procedure STAGE 1 REMOVAL OF INTRANASAL SCAR Z PLASTICS TO INCREASE NOSTRIL CIRCUMFERENCE SPLIT SKIN GRAFT Incise the buccal sulcus between the lateral alar attachments

Elevate the lip and columella

Dissect thoroughly all lining scar up to and about the pyriform margin Elevate slightly the covering skin along this margin

Adjust the remnants of the upper and lower lateral cartilages

Perform a small Z plastic on the skin of the nostril floors near the columella to increase the circumference of the nostrils

Make a prosthesis or a Stent mold which will elevate and distend moderately without vascular change the dissected half of the nose Cover this with split skin (0 016) raw surface out, instil Fibrin Foam, insert and suture the buccal sulcus incision Insert a narrow strip of Penrose drain (Fig. 376 *c d* p 555)

Dress with an eye pad applied with moderate pressure

An interval of eight days elapses.

STAGE 2. REMOVAL OF MOLD REPLACEMENT WITH AN ACRYLIC PROSTHESIS Incise the columella at its lip attachment. Remove the mold and make a plastic impression of the mold from which a stone or wax

duplicate of the mold is made From this, make an acrylic resin duplicate divided into two parts longitudinally Insert these and suture the columella These halves of the prosthesis may now be removed through the nostrils

An interval of five weeks elapses.

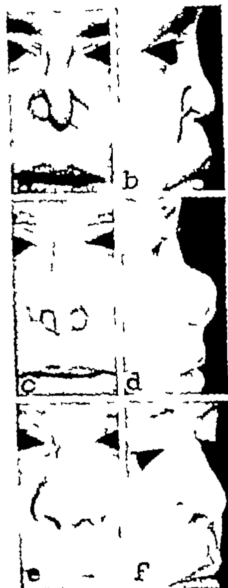


Fig. 376 Luetic deformity cancellous iliac bone graft for the dorsal ridge. (See p. 38 for detailed discussion)

STAGE 3 One half of the prosthesis was removed. The graft was in excellent condition The mold was replaced

An interval of six weeks elapses

STAGE 4 BONE GRAFT TO PRODUCE THE DESIRED ANTERIOR SUPPORT SHAPE AND HEIGHT OF THE NASAL RIDGE Incise along the external border of the lip of the ilium from the anterior superior spine posteriorly about

dried and reinserted at proper intervals until the organization of the graft has become complete and the cartilage support is to be inserted. Various types of prosthetic support can be devised and fitted in dental laboratories (Fig 375 *c d*)

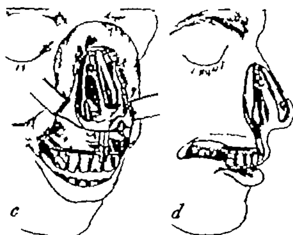


Fig. 375 (continued) *c* and *d* Appliance to maintain shape of nose during organization of skin graft and before implantation of cartilage support. (After Gillies, from Sheehan Plastic Surgery of the Nose. P B Hoeber Inc.)

Luetic Saddles. The following is a luetic case with large loss of the left nasal process and articulating margin of the nasal bone, almost total loss of the septum extensive loss of lining tissue and finally marked scar formation and contraction

The ultimate ridge support differs from the preceding case

Procedure STAGE 1 REMOVAL OF INTRANASAL SCAR Z PLASTICS TO INCREASE NOSTRIL CIRCUMFERENCE SPLIT SKIN GRAFT Incise the buccal sulcus between the lateral alar attachments

Elevate the lip and columella.

Dissect thoroughly all lining scar up to and about the pyriform margin. Elevate slightly the covering skin along this margin

Adjust the remnants of the upper and lower lateral cartilages

Perform a small Z plastic on the skin of the nostril floors near the columella to increase the circumference of the nostrils

Make a prosthesis or a Stent mold which will elevate and distend moderately without vascular change the dissected half of the nose Cover this with split skin (0 016) raw surface out, instil Fibrin Foam insert and suture the buccal sulcus incision Insert a narrow strip of Penrose drain (Fig. 376 *c d* p 555)

Dress with an eye pad applied with moderate pressure

An interval of eight days elapses.

STAGE 2 REMOVAL OF MOLD REPLACEMENT WITH AN ACRYLIC PROSTHESIS Incise the columella at its lip attachment. Remove the mold and make a plastic impression of the mold from which a stone or wax

duplicate of the mold is made. From this, make an acrylic resin duplicate divided into two parts longitudinally Insert these and suture the columella. These halves of the prosthesis may now be removed through the nostrils.

An interval of five weeks elapses

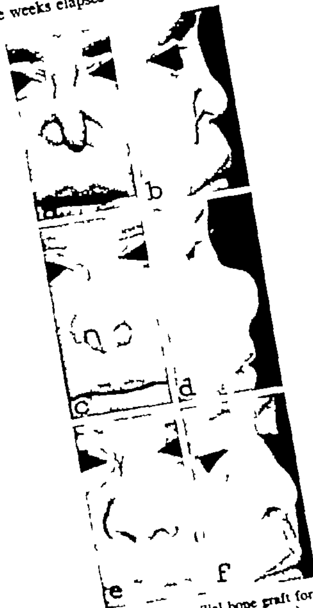


Fig. 176 Luetic deformity: cancellous iliac bone graft for the dorsal ridge. (See p. 38 for detailed discussion.)

STAGE 3 One half of the prosthesis was removed The graft was in excellent condition The mold was replaced

An interval of six weeks elapses

STAGE 4 BONE GRAFT TO PRODUCE THE DESIRED ANTERIOR SUPPORT, SHAPE AND HEIGHT OF THE NASAL RIDGE. Incise along the external border of the lip of the ilium from the anterior superior spine posteriorly about

3¼ inches (9 cm) Separate the soft parts 1 inch (2.5 cm.) inferior to this incision. Incise a rectangle of cortex inferior to the lip 3¼ inches by 1 inch (9 by 2.5 cm) with a double-edged chisel. Make the chisel cuts to the mesial cortical wall. Separate the external cortical plate and elevate the outlined block of cortical bone Return the cortical plate Suture the soft tissues and the incision

Carve the block of cancellous bone to the desired shape and size. Retain the shaved chips

Make a curved incision through the skin and periosteum across the glabella. Carry the periosteal incision down the midline about two thirds the length of the nasal bones Elevate the periosteum laterally for several millimeters Curet the surface or produce some fresh surfaces with a hand burr Treat the superior bone surface similarly

Elevate the skin from the fascia down to the tip Insert the carved bone Use the bone chips (carvings) on the sides of the inserted bone to produce the desired contour

Suture the skin incision with 00000 Dermalon

Dress the nose with horizontal strips of 30 mesh gauze applied with collodion (U S.P) to fix the contour Apply an eye pad and a metal nose splint (see Fig 89 p 126) Pack the anterior vestibule lightly with iodoform ribbon gauze

An interval of four months elapses.

STAGE 5 CARTILAGE SUPPORT IN BOTH ALAE Make an incision in the nostril skin lining parallel and 3 mm. superior to the free border Dissect the covering skin from this lining slightly above the alae Insert a thin plate (⅜ by ⅝ inch—1 by 1.5 cm) of cartilage Close the incision with two or three interrupted sutures.

Dress with iodoform gauze pads in the nostrils and 30 mesh gauze strips applied with collodion to maintain the shape (see p 504)

Saddle Nose—Lower and Upper Half: Congenital, Traumatic and Suppurative

The nose with congenital maldevelopments of the bony arch—nasal processes or nasal bones—or with either faulty development or misplacement of the quadrilateral cartilage should be left untouched until near puberty when the various bony segments and cartilages have reached their full development Earlier surgery even without resections and excisions may retard or inhibit growth There is one exception however in spite of this. The determining factor is not cosmetic but, rather obstructed respiration with its several developmental consequences A septum *reconstruction properly performed is not only warranted but imperative* A limited experience with this procedure beginning twelve to fourteen years ago serves to assure the author of normal growth

The traumatic saddle in the upper bony half of the nose may result from early injury and retarded development, but, more frequently from violent injury later which fractures and spreads the nasal processes of the maxillae and depresses the nasal bones.

Such injury frequently produces green-stick fractures and displace

ments of the quadrilateral and tip cartilages and not infrequently fractures with separation and displacements of the fragments or sections. This occurs also quite independently in the lower half and tip of the nose.

The surgical traumas—excessive and badly located cartilage removal, as well as torsion with biting and extracting instruments, frequently result in depressions or saddles of the ridge, and so forth.

The septal suppurations resulting from infections of various etiologies cause many degrees of liquefaction, scar formation and contraction, producing several types of concavity or saddle.

Requirements: Complete rhinoplasty and implants in some cases (the rhinoplasty will be separately discussed in the following section); bone, cartilage and dermal support, or in occasional cases, all three.

Reconstruction in the Upper Half: Bony Arch

The base of the bony arch—the origin on the maxillae of the nasal processes—is either of proper width for the type and width of face or is made so (see Cosmetic Rhinoplasty, p. 560). The depressed bony arch may have elevated the tip of the nose to a point requiring correction. This will influence the type and length of the implant used for the total correction.

Either cartilage or bone may be used. Cartilage is readily carved to provide the thin strip (2 mm.) which is introduced between the tip cartilages and has the advantage of no absorption, which occurs to some extent in implanted bone that has no function as such. It serves to easily retain the tip in its normal position. Cartilage fitted on the bony arch per se and with its superior thin end under the periosteum, may become sufficiently fixed by its fibrous capsule as to have little or no movement when the nose is handled, but the converse is the usual situation. This is particularly true in those cases in which the implant extends from the tip to the glabella. Figures 385 and 386 (p. 571) present a construction with costal cartilage with the desired result.

Bone, the cancellous structure of the ilium, is the ideal implant. It may be planted either as a carved piece which will fuse with its bony base or as chips molded to proper contour and held in shape by a dressing until fusion occurs. The carved implant may extend beyond the pyriform border to furnish an adequate ridge support, together with the adhesion and scar formation between the subdermal surfaces of an overcorrected skin covering held in position by a proper splint dressing. This results in structure and mobility hard to differentiate from the normal.

Dermal implants—corium of the skin—produce ideal corrections of some of the depressed deformities in the upper half of the nose and its bordering structures.

Reconstruction of the Lower Half: Cartilaginous Support

The lower half of the nasal ridge support—the quadrilateral cartilage—may present ridge and lateral deformities resulting from congenital malformations or in consequence of other congenital failures, such as

clefts of the palate with displacement or cleft and protuberance of the premaxilla, and so forth The management of these is discussed in the preceding section and elsewhere

Traumatic saddles or depressions result from direct violence producing fractures and displacements from surgical trauma by unwise and exces sive excision as well as the torsion of extracting forceps, and so on

Infections with suppuration from various causes frequently result in sufficient liquefaction scar formation and contraction to produce such deformities.

The depressions or saddles of various degrees may be corrected with implanted carved cartilage pieces, diced cartilage introduced with the "Chondrojet," or finely shredded cartilage by the author's method by free elevation of the covering skin overcorrection by elevation and approximation of the subdermal surfaces with a copper splint ("clothes pin") (see Fig. 89 p 126) by overlapping of separated, rotated upper lateral cartilages remaining attached on their mesial borders, and by dermal inlays.

The carved cartilage piece is the least desirable because its investing fibrous capsule does not provide stable fixation Its superior end moves whenever the tip of the nose is deviated. The diced or shredded cartilage molded into slight overcorrection and held in this position by a splint until proper organization yields splendid results. This is true also of the dermal inlay

Procedures *Cartilage Support* Either autogenous cartilage from a free rib or the last fixed rib or preserved cartilage may be utilized. The availability qualities and behavior of implanted, preserved cartilage offer little excuse for the discomfort and disability following the procurement of autogenous cartilage (p 131) except in infants and adolescents

Make an intranasal incision in the skin from the tip to the base of the columella Dissect the soft tissues to form a pocket in the columella, and extend this inferiorly to the region of the anterior nasal process. Free the skin along the ridge from the tip to the glabellar region and laterally on each side Insert a prepared ridge and columellar cartilage of proper shape If autogenous cartilage is used, a section of perichondrium may be left, as depicted in Figures 385 and 386 (Gillies) to permit notching and hinging of the cartilage and its implantation in a single piece If pre pared cartilage is utilized, the distal (tip) part of the cartilage must be *mortised and the columellar post fashioned into a tenon or a* wedge-shaped point to insert into the socket. The two pieces are fixed in position with a catgut suture This cartilage should have a thin ridge and a base adequate to repair the defect. Its tip should be carved to thin propor tions in order to maintain the proper contour of the region (Figs. 385 386 p 571)

Close the columellar incision with interrupted horsehair sutures. Apply a cotton eye pad and a copper nose splint with strips of adhesive tape (Fig. 89)

Diced Cartilage (Chondrojet, p 133) Make an incision ¼ inch (0.5 cm.) in the skin of the nostril lining parallel to and 3 mm from the free border, beginning at the curved junction of the lateral and medial crura of the tip cartilage and extending laterally Elevate the covering skin from the cartilage introduce a round-nosed instrument (scissors curved on the flat or a needle forcep) and bluntly dissect the skin from the tip to the glabella. This elevation is carried laterally sufficiently to allow the desired elevation without tension

Introduce the diced cartilage with the Chondrojet, suture the incision mold the cartilage to slightly overcorrect the depression (allowance for later contraction) Apply a strip of 30 mesh gauze with collodion (U.S.P) a thin eye pad and a metal splint (Fig 89 p 126)

Shredded Cartilage The preparation of the covering skin and introduction of the cartilage, as well as the dressing, is the same as the preceding The reason for use of the cartilage in this form is discussed under Cartilage (p 131)

Rotated Overlapping Lateral Cartilages Incise through the skin and cartilage 3 mm from the nostril border around the lateral wall to the membranous septum Separate the covering skin from the cartilage on both sides Elevate the upper lateral cartilage from its lateral border to within 3 mm. of its mesial (septal) border

If only one cartilage is necessary pass a needle with 00000 plain cat gut beneath the skin from the opposite side and through the edge of the rotated cartilage and back out of the side of beginning. Traction of this suture will rotate or roll the cartilage over the septal cartilage to the opposite side Pass the suture through the septal attachment of the cartilage on this side, and tie Pass one or two similar sutures

If this rolled cartilage is not sufficient to correct the depression or saddle, utilize the remaining lateral cartilage to overlap the rotated one and suture

Approximate the alar incisions with one or two 00000 Dermalon sutures and dress as previously indicated.

Skin Elevation, Overcorrection Splinting Incise the nostril borders of the lining as indicated in the preceding discussion. Elevate the external skin

If the shape and position of the upper and lower lateral cartilages do not provide the desired contour when the covering skin is elevated insert a straight scissors and incise the lining and cartilage along its entire septal attachment. Trim this border, if indicated. Excise a small V-shaped bit of skin and cartilage from the residual junction of the two crura in the tip of the nostril.

Elevate the covering skin with the thumb and finger to overcorrect its height and desired curved ridge contour Fix it in this position with a strip of 30 mesh gauze applied with collodion (U.S P) Apply enough collodion to both sides—not to the curved top—to give it a stiff board like character as it dries and contracts Cover with a thin eye pad and

apply a thin metal splint (Fig 89 p 126) compressed like a "clothes-pin" This may be covered with a strip of 30 mesh gauze applied to the bordering cheek skin with collodion or adhesive tape The splint is retained or replaced for two to three weeks. The inside of the nose is lightly packed with ribbon iodoform gauze until the lining adheres The end result is very satisfactory

DERMAL GRAFT FOR LOSS DISPLACEMENT OF THE QUADRILATERAL CARTILAGE

Procedure. Preparation of the field is the same as described previously The skin for the dermal graft is obtained and inserted as described on page 135 Closure and dressing are described in the foregoing. The splint is retained for seven or eight days to control the swelling and prevent bloody and serous collections. The defect should be overcorrected about 20 per cent to allow for subsequent organization and contraction (Figs. 365 *c* 384) This procedure may be repeated at intervals until the desired contour is obtained

COSMETIC RHINOPLASTY

This is an exacting type of corrective surgery demanding the best planning, esthetic judgment and technical skill of the operator for the accomplishment of pleasing results both cosmetically and physically It deals with *external deformities* which may be either congenital or traumatic in origin, as distinguished from the previous discussions.

There is no fixed cosmetic formula to follow Certain measurements, angles, and the like are of help but necessitate variations to satisfy the several types of faces and their measurements. The surgeon must use his judgment and, frequently should have the opinion of his operating staff in choosing certain features of the procedure He must constantly evaluate the changes which may occur in the healing process.

This type of surgery deals with depressions or saddles in the dorsal ridge abnormal angles of the nasal bones and cartilage on the ridge ("hump noses") deviations due to fracture without other deformity various distortions of the nasal tip and the alae, and so forth

The patient should be free from acute or chronic infections of the nose and sinuses Clean the nose internally with suction Anesthetize the nose with cotton pencils wrung out of 10 per cent cocaine in 1 2000 epinephrine chloride Place these the length of the nose from the floor to the top This produces perfect anesthesia and largely prevents fine capillary bleeding. The external nose is blocked or infiltrated with 0.5 per cent procaine containing 25 minims of epinephrine chloride to the ounce The internal nose may be perfectly anesthetized with three cotton-wound applicators moistened with epinephrine chloride (1 1000) and dipped in cocaine powder One of these is placed high up between the anterior end of the middle turbinal and septum to anesthetize the ethmoidal nerve a second is placed against the lateral wall above the posterior end of the inferior turbinal to reach the sphenopalatine nerves distributed on the

septum and so on the third is placed on the floor against the posterior end of the inferior turbinal (Fig. 377, *a*)

The external nose bordering face, and so forth and vestibule are prepared by gently sponging with detergent soap (formula G 11) The hair is clipped from the vestibule and the nose packed gently with moist ribbon gauze A black sterile cap with an opening for the nose is drawn over the head, and the usual drapes are added.

A classical procedure for a nose with an abnormal angle of the nasal bones and so forth—a "hump nose"—with a dependent tip and an acute angle of junction of the columella and lip will describe the details of a complete rhinoplasty

Procedure. Elevate the nostrils and tip with a two-pronged retractor Retract the ala and columella with fine sharp hooks Make an incision

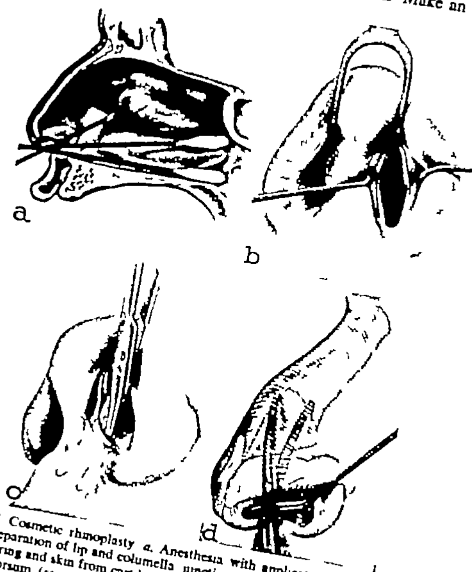


Fig. 377 Cosmetic rhinoplasty *a*. Anesthesia with applicators. *b* Intranasal incision. *c* Separation of lip and columella junction about the nasal spine, separation of the covering and skin from cartilage and bone *d* Excision of lining and cartilage from the dorsum (septum)

parallel and 3 mm. superior to the nostril margin through the skin and cartilage from a point near the base of the ala through the curved junction of the lateral and median crura of the lower lateral cartilage and on down the membranous septum to the nasal floor (Fig. 377 *b*) This incision differs from the usual orthodox one along the margin of the upper lateral cartilage The latter is frequently followed in cases of tip and alar corrections by a final incision of the type described, which offers a complete and simple approach to the total requirements.

Insert a thin scissors, curved on the flat and with rounded blade ends, into the bottom of this incision and elevate the lip and columellar junction about the nasal spine (Fig 377 *c*)

Insert a sharp hook in the nostril lining and cartilage and one in the nostril margin to retract them. Insert the scissors curve down and separate bluntly the covering skin from the cartilages and bone up to the glabella and slightly on the frontal bone (Fig 377 *d*) Continue this separation over the lateral surfaces and the tip

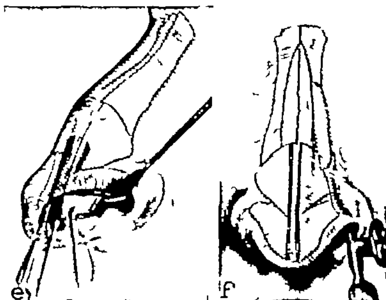


Fig. 377 (continued) *f* Excision of the protuberance with a nasal saw

Insert a straight scissors, one blade under the covering skin and the other in the nose to include the lining and the cartilage Incise this along the septum Pass a suture through the inferior-mesial end of the lining flap catch it in a small hemostat, and use it as a retractor (Fig. 377 *e*)

Insert an Aufricht retractor to elevate the skin along the entire dorsal ridge and afford a clear view of the bony and septal framework Use a nasal saw to cut the protuberant bone along the desired line (Fig. 377 *f*) Then continue this incision along the septal cartilage with a small knife (Bard Parker No 15) (Fig. 377 *g*) Grasp the excised cartilage and bone with a hemostat and remove it (Fig 377 *h*) Smooth the sawed bone edges with a concave nasal file (Fig. 377 *i*)

The diploic bone between the paper plate, the frontal, the nasal process of the maxilla and the nasal bone, is now accessible. It must be removed to permit the desired approximation of the nasal processes which are to be incised later along their line of origin from the maxillae Insert a thin, flat, double-edged chisel along the septum and alternately along the edge of the cut process to remove a wedge-shaped piece of this bone up to

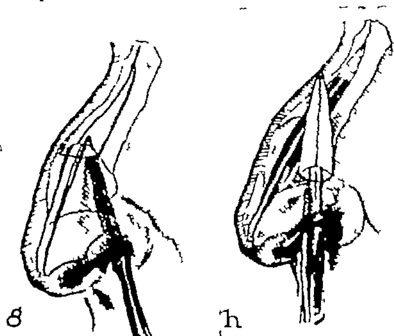


Fig. 377 (continued) *g* Cartilage excised along the line of the bone cut with a knife *h* removal of bone and cartilage.

the frontal (Fig. 377 *j*) Clear the bone particles with a flat, bowl curet (Fig. 377, *k*)

The nasal processes may now be freed They may be incised either with a nasal saw introduced intranasally or with a 2 mm double-edged chisel punctured through the skin

The saw may be introduced after an intranasal incision along the lateral pyriform border and elevation of the soft tissues from the periosteum up to the frontal attachment of the process The bone is cut through to the periosteum on the intranasal surface (Fig. 377 *m*)

The chisel is introduced at about the midpoint of the process. It should be sharp and should cut the soft tissue cleanly The single puncture is sufficient. Slant the chisel down to about 3 mm from the lateral margin of the pyriform edge of the bone and cut through to the intranasal periosteum Leave this small attachment for the final incision to stabilize the process as it is incised superiorly Continue cutting superiorly to the frontal attachment and then incise this 3 mm. remnant. The process should now fracture mesially with thumb pressure but will not do so if the frontal attachment is dense. In this event, finish a similar bony incision on the opposite side and then introduce a narrow beveled chisel —the bevel against the frontal bone—in the midglabellar line at the

articulation of the nasal and frontal bones Incise this and continue laterally on both sides through the articulations of the nasal processes and frontal bone The processes are now free and readily approximate

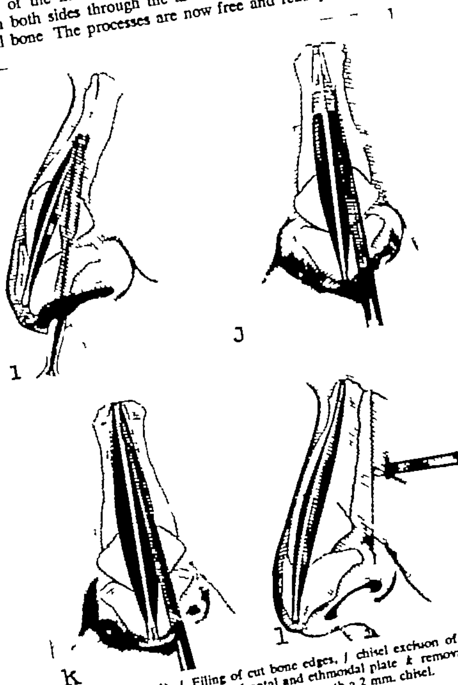


Fig. 377 (continued) *I* Filing of cut bone edges, *J* chisel excision of the bone between the nasal process and the frontal and ethmoidal plate *k* removal of bone particles with a curet *l* incision of nasal process with a 2 mm. chisel.

in the midline The 3/16 inch (4 mm) scar in the glabella and the 1/8 inch (2 mm) scars on the lateral sides of the nose are barely discernible after six to eight weeks (Fig 377 *l*)

Put a sharp hook in the cartilage and skin remnant of the curved junction of the lateral and medial crura of the lower lateral cartilages which

is inferior to the incision in the top of the nostril, and retract it outward. Remove a small V with the scissors to narrow and produce a better tip contour (Fig. 377, *n*)

Make traction on the suture through the lining flap, and excise this along a line that permits approximation with the initial incision without

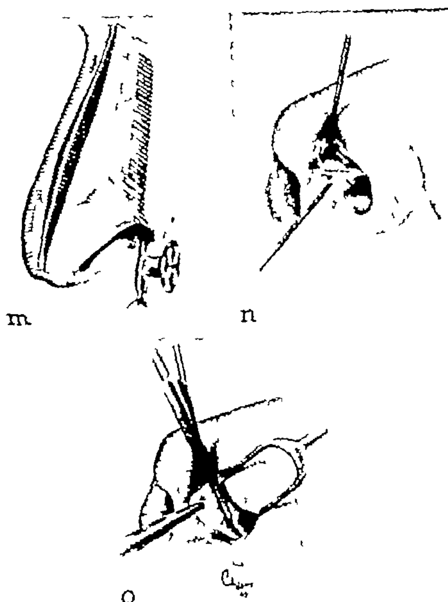


Fig. 377 (continued) *m* Incision of nasal process with a saw· *n* excision of a V from the crural junction of the tip cartilages *o* excision of excess lining and cartilage.

buckling or fulness of the alar lining (Fig 377 *o*) Trim the mesial border of the lining flap if this is indicated.

Excise from the inferior border of the septal (quadrilateral) cartilage a wedge-shaped (base anteriorly) or rectangular strip which will provide the proper angle between the columellar tip line and the lip This

must be carefully judged and not follow some set esthetic formula This part of the nose must be adjusted particularly to the type of face

The tip of the nose is elevated 2 to 4 mm above the desired final position to allow for the contraction of the linear incision in the membranous septum running from the tip to the nasal spine This is accomplished by passing sutures through the full thickness of the septum and columella, as shown in Figure 378 P_1 and tied as seen in Figure 378 P_2 and P_3 The incision edges in the columella are separated by dissection to admit the inferior edge of the quadrilateral cartilage, and excess skin is ex

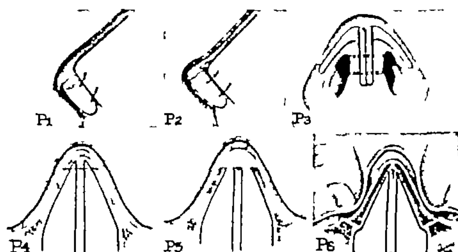


Fig. 378 P_1 Sutures passed through the inferior margin of the quadilateral cartilage and reintroduced to elevate the tip in overcorrection P_2 sutures tied, over correction of 2 or 3 mm. P_3, tip elevated with fixation columellar sutures, approximated lateral crura P_4 cross section of "hump" and line of saw cut P_5, cross section of saw and knife excision leaving a flat base of the cone of excision P_6, fracture and approximation of the nasal processes with the thumb and finger (See p. 562 for detailed discussion.)

cised if indicated and approximated to the septal covering with interrupted 00000 Dermalon Figure 378 P_4 and P_5 shows a cross section of the bone (hump) removed and the cone-shaped defect after the excision Figure 378 P_6 pictures the approximation of the nasal processes by thumb and finger pressure after incision of the bony processes.

Dressing. Apply a strip of 30 mesh gauze, ⅜ inch (1 cm) wide, around the lower end of the nose with collodion (U S P) An end of the strip is fixed to the side of the ala at its lateral margin (sulcus), and its lower edge along the nostril margins about 3 mm. above the rolled border The collodion is applied on one side to fix the strip up to the beginning of the dorsal ridge and allowed to dry The strip is folded over the opposite side the alae are compressed with the thumb and finger and collodion is applied and dried as formerly This leaves the strip free over the dorsal ridge and slightly overcorrects the elevated tip when the splint is applied.

A folded pad of ribbon iodoform gauze is placed in each nostril. One inch gauze is folded to make a pad of proper width to reach from the nostril floor to its apex and of ⅛ inch (3 or 4 mm) thickness. The length of the pad is cut so as to allow it to extend from slightly outside the nostril to ¼ inch (0.5 cm.) beyond the skin incisions in the alae This permits compression of the alae against the pads and septum in their desired shape A strip of 30 mesh gauze is now applied across the one running around the end of the nose the alae are slightly compressed and the strip is drawn across the columella and applied to the gauze on the opposite ala.

A thin eye pad is cut to fit the surface of the nose This is covered with the splint previously described (Fig. 89 p 126) The splint is compressed from its outer margins on the cheek skin with the thumb and finger so as to push the skin toward the dorsum and elevate it along the ridge The splint is held in position with adhesive tape The splint and packs are not disturbed for four or five days, if the nostril dressings remain clean The gauze strip applied to the end of the nose remains ten to twelve days until the healing is adequate to maintain the desired form The nostril pads are discontinued after the fourth or fifth day and the nose is cleared with a suction pipet.

This simple dressing has been described in detail because it permits obtaining easily and definitely the form and shape of the healing process.

The following cases are presented to illustrate the results of a simple cosmetic rhinoplasty as well as such procedure supplemented by the secondary introduction of dermal and bone implants in order to obtain the desired result.

Case I. This patient presents a marked nasal protuberance (distance from the maxilla to the dorsal ridge) an abnormal angle of the nasal bones from their frontal articulation (hump) with abnormal height of the quadrilateral cartilage, and a retracted junction of the columella and lip producing the appearance of a long philtrum (Fig. 379 *a b*) The result of the rhinoplasty is presented in Figure 379 *b*

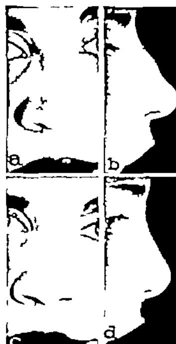


Fig. 379

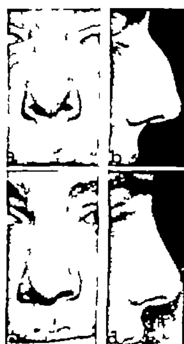


Fig. 380

Fig. 379 Case I abnormal dorsal ridge (hump") deviation retracted junction of columella and lip producing appearance of long lip

Fig. 380 Case II small convexity of nasal bones ("hump") small concavity saddle, of the lower half of the ridge, and marked convexity at the junction of the crura of the lower lateral cartilages.

Case II This patient presents a small convexity (hump) of the distal third of the nasal bones, a small concavity (saddle) of the lower half of the ridge and a marked convexity at the junction of the two crura of the lower lateral cartilage producing a broad tip (see Fig. 380 *a b*) The hump was corrected with a file the saddle by elevation, overcorrection and splinting of the ridge skin covering and the tip by resection of the lining and cartilage at the junction of the two crura. See the preceding discussion.

Case III This patient presents a flat bridge due to fracture and displacement of the quadrilateral septal cartilage and fracture and dislocation of the right alar crus of the lower lateral cartilage and horizontal nostrils as the result of direct anterior force (see Fractures, p 121, Fig. 86 *a b* p 124 Fig. 381) The result of septum reconstruction and rhinoplasty is seen in Figure 381, *c* and Fig. 86)

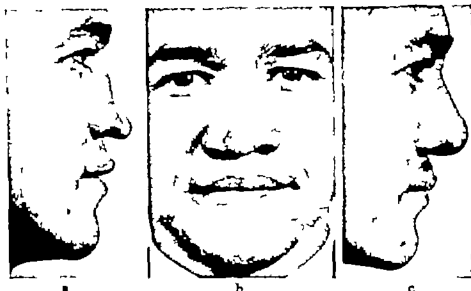


Fig. 381 Case III *a* and *b* fracture and displacement of quadrilateral septal cartilage and the right alar cartilages *c* appearance after reduction and reconstruction.

Rhinoplasty with Secondary Dermal Graft

Two types of cases in this category are discussed.

Case IV This patient suffered direct trauma to the upper bony half of the nose which depressed the nasal bones and fractured with lateral displacement, the nasal processes (Fig. 382, *a*) No distortion of the alae with widening of the lobule and distortion of the nostrils resulted. Recon



Fig. 382. Case IV

struction is accomplished by a rhinoplasty to establish a normal width of the base of the bony arch and a secondary dermal inlay to provide the desired dorsal ridge (Fig 382 *b*)

Case V This patient presents a saddle of the upper half of his nose This results from direct trauma which depressed the nasal bones, fractured and spread laterally the nasal processes to broaden the nose, and flattened and spread the lower alar portion (Fig 383 *a b*)

The condition demands a complete rhinoplasty to establish a proper base or foundation excision of the junction of the crura of the lower lateral cartilages with reapproximation and a secondary addition to this foundation to produce a desired dorsal ridge position and character of the tip and angle of columellar attachment to the lip These things were *accomplished in this manner by the use of dermal inlay in the upper two* thirds of the nose. The end result is presented in Figure 383 *c d*

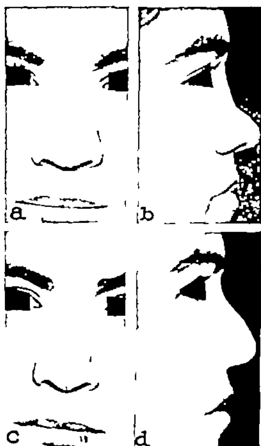


Fig. 383 Case V rhinoplasty with secondary dermal graft.

Case VI The patient has a convexity of the distal end of the nasal bones ("hump") and a small concavity (saddle of the upper half of the cartilage ridge) (Fig. 384 *a* p 571) The hump was removed by filing and the saddle corrected by a dermal inlay The result presented in Figure 384 *b* shows a slight ridge depression as the result of organization (shrinkage) of a double layer of dermal inlay which materially over corrected the depression This requires a second single layer of dermal inlay



Fig. 384 Case VI saddle nose. *a*, Effect of loss and displacement of the quadrilateral septal cartilage; *b* appearance after implantation and organization of a dermal graft

Rhinoplasty with Secondary Cartilage Graft

Case VII This patient (see Figs 385 386) underwent a primary rhinoplasty to narrow the base of the bony arch and provide the founda

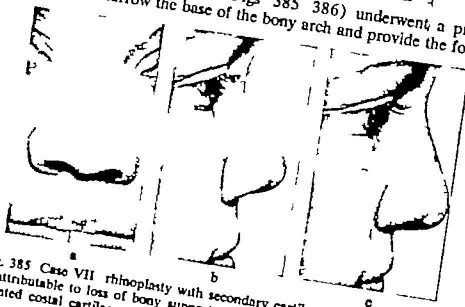


Fig. 385 Case VII rhinoplasty with secondary cartilage graft. *a* and *b* Saddle nose attributable to loss of bony support *c* appearance after reconstruction with implanted costal cartilage.



Fig. 386 Plan and form of a nasal support formed by autogenous cartilage. A part of the perichondrium is retained on the anterior surface of the point of the V-shaped notch to permit hinging and abutment of the columellar and ridge portions of the implant. (After Gillies.)

A partial septal reconstruction (see p 577) a partial rhinoplasty to lower the bone in the glabellar section of the nasal arch and to correct the tip defects, with an iliac cancellous bone graft to establish the desired dorsal ridge are presented in Figure 388 *d e f*

Case X (see Congenital Disabilities, Fig. 401 p 590) The repetition of this case here is for emphasis It has many similarities to the preceding case One of the principal cosmetic corrections resulted from a rhinoplasty followed by iliac cancellous bone graft.

Deviated Nose: Normal Arch Contour- Old Fracture

This disability (see p 121) results from lateral violence which fractures and displaces the nasal process of the side opposite to the force the nasal process and bones on the side of the trauma from the maxilla and their frontal articulation This swings the entire bony arch to the opposite side creating a long, flat side in the direction of the force and a short steep nasal side opposite (Fig. 389 *a* p 575)

The septum is carried with the attached bone, producing a high deviation contacting the middle turbinal bone on the short side, and a displaced posterior border dislocated from its V groove in the vomer frequently contacting the inferior turbinal bone on the side of the trauma. This displaced cartilage carries the mucoperichondrium of both sides with it. The natural healing process proliferates bone from the lip of the vomer to support the free displaced cartilage edge resulting in a <-shaped shelf which partially or totally obstructs respiration in the lower half of the nose (Fig. 389 *a*)

The cartilaginous bony shelf on the displaced septum and the high convexity contacting the middle turbinal bone on the other side must be corrected to eliminate the effects of turbinal contact with consequent congestion, excess mucus secretion and so on and so forth These things may be accurately accomplished to produce a normal nose, both functionally and cosmetically

Requirement. Removal of bone from the long, flat side incision of the nasal process along the maxilla on the short steep side septal reconstruction (see p 577)

Procedure. Determine the center line of the dorsal ridge with a line through the midglabella, center of the philtrum and the chin (Fig. 389 *a 1 2*)

Measure the deviation from this line to the distal nasal articulation (Fig. 389 *a 3 4*) This is the base of the triangle giving the angle of deviation at point 5 in Figure 389 *a* This bony triangle is removed later

Prepare and anesthetize the nose as indicated for rhinoplasty (p 560)

Make an incision through the mucoperichondrium on the shelf side parallel to and a few millimeters above the inferior border from the anterior cartilage (ridge) border around the shelf to the floor

Elevate the mucoperichondrium on this side of the septum above and below the shelf to the nasal floor beyond its posterior end.

Incise the curved septal cartilage for its entire length 2 or 3 mm above

the edge of the shelf Elevate this cartilage strip from the mucoperichondrium of the opposite side with a submucus elevator and remove it. Either excise the bony shelf from the vomer with a double-edged thin flat chisel, or fracture and remove the lip with a biting forcep

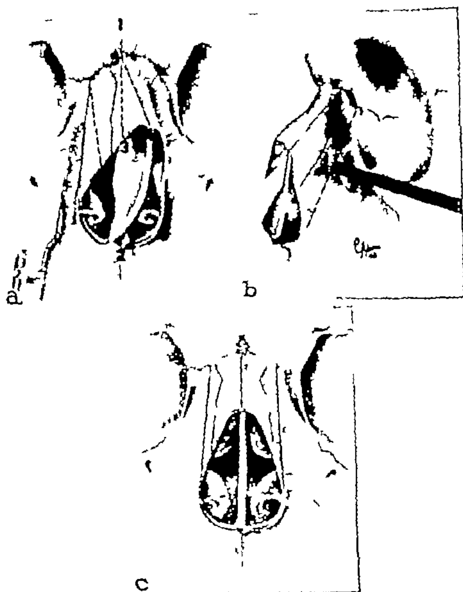


Fig. 389 Deviated nose normal arch contour old fracture. (See p. 574 for detailed discussion and significance of the numbers.)

Incise the mucosal attachment of the upper lateral cartilage along the pyriform margin from the septum to the lower turbinal attachment. Elevate the soft tissues from the periosteum of the nasal process of the maxilla lateral to its origin on this bone Introduce a nasal saw (Fig. 389 *a*) along this attachment line and cut to the intranasal periosteum from the outer margin of the pyriform opening to the frontal articulation Mark the base of the triangle or angle of deviation and incise with the

saw from this point to the end of the former cut in the frontal articulation (Fig 389 *a*) Elevate this wedge of bone from the intranasal periosteum and remove it.



Fig. 390 Case X fracture with lateral deviation. (See p. 574 for detailed discussion.)



Fig. 391 X-ray picture of a comminuted displaced fracture of the nasal process. (See p. 574 for detailed discussion.)

Determine the line of attachment of the short, steep nasal process with the maxilla, introduce a sharp double-edged 2 mm chisel, and incise this bone line as described under Rhinoplasty (Figs 377 389 *b* on pp 562, 575) Fracture with the thumb and finger If this is not possible

introduce a narrow, bevelled chisel and incise the frontal nasal articulation as described under Rhinoplasty (p 560) Now place the bony arch in its normal position by lateral pressure and rotation. This will carry the septum with it.

If the convexity in the septum retains its contact with the middle turbinal bone, make an anteroposterior incision through the entire cartilage to the perichondrium along the superior, middle and inferior borders of the convexity Introduce a long blade nasal speculum on the side of the convexity and fracture the perpendicular plate of the ethmoid, carrying the entire septum to a vertical position.

Suture the septal incision

Place three pieces of nasal bismuth paste gauze packing in each side of the nose Use the nasal speculum to maintain the septal position placing the strips with moderate pressure between its blades Place the first on the floor the second high up and the third in the middle Cut the anterior ends at the nostril borders, fold them into the nostril and cover with a small plug of cotton These nasal packs are prepared as follows Fold an 8 by 8 inch (20 by 20 cm) square of dressing gauze ⅜ inch (1 cm) on each border to conceal the raw edges. Continue folding ⅜ inch (1 cm.) on opposite sides toward the center until the last folding results in a strip about ⅜ inch (1 cm) wide Dip these in melted autoclaved bismuth paste (U S P) Place the gauze collodion strips and splint them on the nose as described under Rhinoplasty (p 566) Figure 389 *c* (p 575) pictures the reduced sections described

The patient presented in Figure 390 *a* (p 576) suffered violent trauma on the right side of the nose which carried the bony arch and the septal attachment to the left. The septal deviation to the left and its dislocation from the V-shaped groove in the vomer on the right carried the nasal tip to the right of the philtrum The intranasal picture is as described above Figure 390 *b* presents the result of the procedure discussed.

The condition presented in Figure 391 (p 576) is a similar lateral trauma with comminution and displacement of fragments of the nasal process This resulted in a marked cosmetic disability and continuous pain from incarcerated, torn sensory nerve ends

The corrective procedure is the same as above except that the displaced fragments created no "long flat side" from which removal of bone was necessary The free elevation of external soft tissues from the periosteum sectioned the sensory nerves. A long, thin-bladed forceps protected with rubber tubing, served to mobilize the fragments and reduce them to normal position

Septum Reconstruction

A reconstruction of the septal elements to eliminate deformities of several types for restoration and function and contour is obviously quite contrary to attainment of part of the same result by resecting or excising submucously the various deformities Resection of posterior parts of the

quadrilateral cartilage and perpendicular plate of the ethmoid may be combined with reconstruction in patients past puberty

Disturbance of essential blood supply to developing bone and cartilage inhibits or materially retards its growth. The adult nose acquires its size and form by growth of the septal elements resting upon the vomer as a base. It is obvious that excision at an early age, with no growth restoration of these parts *is a surgical mistake*

Frequently congenital or acquired deformities obstruct nasal respiration and create developmental and health situations which demand correction A septal *reconstruction properly performed* permits perfect correction with no subsequent disturbance of development. Frequent experience with this procedure beginning fourteen years ago permits the author to make this positive statement based upon clinical observation. Such a procedure has been necessary twice to permit the infants to nurse. Normal development of these noses has been observed.

The lower mobile half of the nose depends upon the dorsal and inferior parts of the septal cartilage for its support and normal form They *should not be removed. It is possible to maintain these features by reconstruction* and regulated scar formation in the adult—*never in the infant and growing child* This support is comparable to the ridge pole and its supporting stakes in a tent.

We are indebted to the late Myron Metzenbaum for our modern recognition and technical handling of this problem

Procedure. Figure 392 *a* presents the dislocated inferior border of the quadrilateral cartilage obstructing the right nostril. Figure 392 *c* pictures the high convexity and the >-shaped shelf resulting from the dislocation and the natural repair to support it.

1 Make an incision to the cartilage along the entire length of the dislocated edge The mucoperichondrium and mucoperiosteum are to be separated on the convex (left) side, and these structures are *not disturbed* on the right side except at the cartilage margin to permit this to be restored to its normal place between the skin structures of the membranous septum and columella

2 Retract the cartilage and so forth and the left soft flap with fine, sharp hooks. *Dissect* with a *small knife the perichondrium from the* left side until it separates readily with an elevator The perichondrium is densely adherent in the average case for about ⅜ inch (1 cm.) (Fig. 392, *b*)

3 Introduce a submucous elevator and separate the covering approximately to but not around the thin edge of the > shelf Separate the mucoperiosteum from the left side of the vomer and beneath the shelf to but not around its edge (Fig. 392, *c* p 579)

4 Incise the cartilage to the perichondrium on the right side along its junction with the ethmoid plate. This is done with a small right angled knife (Freer's) Elevate the periosteum from the ethmoid plate if this is to be excised (adult) Remove a thin strip—$\frac{1}{16}$ inch (2 mm.)—of

cartilage parallel to the incision to permit the cartilage to swing into a normal vertical position (Fig. 392, *d* *e*)

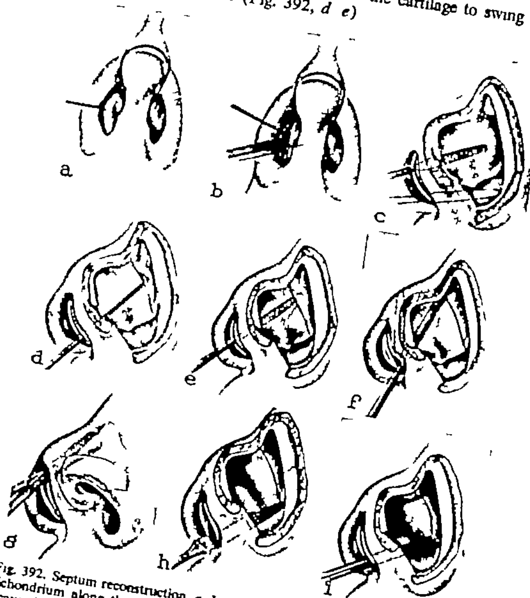


Fig. 392. Septum reconstruction. *a*, Intranasal incision, *b* sharp dissection of the perichondrium along the inferior border *c* elevation of mucoperiosteum on the concave side and beneath the cartilage vomer junction (shelf) on the right side *d* incision of quadrilateral cartilage along the ethmoid plate *e* elevation of the mucoperiosteum from the right ethmoid plate *f* and *g* separation of soft tissues from the anterior edge of the septal cartilage and incision of the lateral cartilages along the septum *h* and *i* incision and removal of excess quadrilateral cartilage stripped along the vomer

5 Separate the soft tissues over the entire anterior edge of the septal cartilage Incise the junction of the crura of the lower lateral cartilage and the junction of the upper lateral cartilage with the septum with scissors. This cartilaginous mucosal lining is short and will ultimately draw the septum laterally if not repositioned (Fig. 392, *f* *g*)

6 Determine the line on the quadrilateral cartilage that will permit it to be reset on the vomer when returned to its normal position Incise along this line to the opposite perichondrium and elevate the strip extending to the edge of the >-shaped shelf (Fig. 392 *h* *i*)

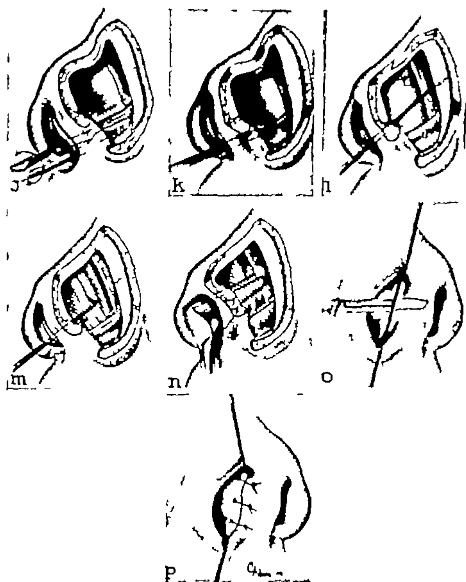


Fig. 392 (continued) *j* Fracture of the vomer and rotation to the midline *k* chisel excision of the bony lip on the displaced vomer *l* and *m* parallel incisions through the cartilage to the perichondrium to correct the convexity *n* excision of the ethmoid plate *o* separation of the skin layers of the columella *p* suture. (See p. 577 for detailed discussion of this procedure)

7 The remaining bony part of the shelf may be eliminated in either of two ways.

(*a*) The periosteum is elevated from the right side of the vomer sufficiently beyond the original incision to admit one jaw of a heavy biting

forceps. The rotation of the forceps will fracture the vomer medially (Fig. 392, *j* p 580) and approximate the lip to the vertical line. This will necessitate removing a second thin strip from the approximating septal cartilage.

(*b*) Excise the remaining bony arm of the > shelf with a thin flat, double-edged chisel and strip it from the remaining soft tissue attachment (Fig. 392 *k*) The author prefers the latter procedure because it does not disturb any blood supply on the right side and leaves a vertically normal vomer

8 Correct the convexity in the septal cartilage by making several parallel incisions to the perichondrium and a cross incision, if necessary, at its midpoint (Fig. 392 *l m*)

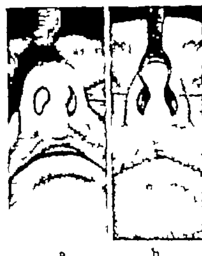


Fig. 393 *a* Displaced septum occluding the right nostril *b* result of correction.

9 If the ethmoid plate is to be partially excised (adult) it may now be done (Fig. 392, *n*)

10 Split the skin-covered layers of the membranous septum and columella to receive the inferior edge of the septal cartilage (Fig. 392 *o*) Suture with 00000 Dermalon (Fig. 392 *p*)

Dress the two sides of the nose with nasal bismuth paste packs (see Deviated Nose p 574) The strips are removed on the second postoperative day and supplemented with a small packing in either nostril to maintain the position of the inferior edge of the septal cartilage This should not be necessary

Figure 393 *a b* presents a patient who had marked dislocation of the inferior border of the septal cartilage with obstruction of the right nostril and a high deviation on the left side The procedure just discussed results in an excellent, normal airway

MALIGNANCY

The various malignancies involving the external surface of the nose require the same radical management as on other body surfaces. Other and increasingly grave, situations arise from the *location* on the nasal

surface the *duration* and *treatment* of the lesion its invasion of the lids and orbit and its erosion of the bony wall with involvement of nasal lining. The lymphatic drainage posterior to the lateral and pos terior pharynx necessitates the most radical exenteration.

Many of the patients consulting the surgeon have had or have at the time lesions which can be well managed by wide excision and im mediate reconstruction coagulation or proper radiation either with x-ray or radium It is unfortunate that many of these patients have been inadequately treated over long periods and present the necessity for extensive destructive surgery a long waiting period and large com plicated reconstructions

The following cases offer examples of the several situations.

Case I. This patient was examined here on August 7 1941 She had had ten years of surface radium treatment beginning in 1927 In 1937 the lesion itself was coagulated with an electric needle. Three years later she moved to the West Coast, where she had twenty-five x-ray treatments. On her return here she received more radium applications. In 1940 she consulted an eminent dermatologist who advised immediate surgery

The examination revealed a dissecting ulcer on the side of the nose above the inner canthus. It burrowed along the lower lid margin to the bony rim and laterally to the junction of the inner and middle thirds of the lids. The lid was indurated ½ inch (1 cm.) lateral to the ulcer There was also marked induration of the entire infra-orbital area of the cheek extending to the lower level of the nose. The right ala was elevated ½ inch (1 cm.) as a result of scar contraction. There was loss of surface tissue. The tumor evidently involved the margin of this ala.

X-ray examination revealed bone destruction of the right infra-orbital ridge, and invasion of the anterior ethmoidal cells. The frontal sinus and antrum were negative.

Operation three weeks later consisted in excision of the medial third of the upper and two thirds of the lower eyelids the distal 1 cm. of the inferior rectus muscle, mesial third of the orbital bony rim (lower) and the nasal process of the maxilla, as well as the anterior and middle ethmoid cells. The infra-orbital soft parts above the periosteum were removed down to the level of the alveolar process (Fig. 394 *b* p. 583)

The rectus muscle was sutured to Tenon's capsule. The cavity at the inner canthus was lightly packed with iodoform gauze. A cheek flap was elevated to the border of the mandible. The nasal skin was elevated over the ridge, the left lateral wall and infra-orbital cheek area. The cheek flap was advanced upward and inward and sutured to the nose flap The upper lid was sutured to the margin of the nasal skin. The lower lid was sutured to the advanced flap. The alar defect remained untouched.

The pathological report was basal and squamous cell carcinoma, grade II.

On September 9 1941 a rectangular flap based at the external canthus was elevated from the cheek and rotated under the dissected lower lid to correct the ectropion. Surgical adhesions were created between the lids.

Repair of lateral and alar loss was made on January 13 1942.

Stage 1 A rectangular flap based on the margin of the defect was outlined on the right cheek. The borders of the distal end of the flap were elevated. A piece of full thickness skin covering and cartilage from the right ear was implanted. The ear skin was undermined and closed by suture (Fig 394 *c d*)

An interval of ten weeks elapsed.

Stage 2 (March 24 1942.) The flap was elevated rotated 90 degrees, and sutured into the defect (Fig 394 *e*)

BLEPHAROPLASTY (May 20, 1942) A rectangular flap, base mesial, was elevated from the upper lid. The canthus and lower lid were dissected free and elevated. The flap was rotated and sutured in the residual defect (Fig. 394 *f*)

By January 23 1945 there was evidence of a tumor deep in the orbit and in the canine fossa wall of the maxilla. Potential useful surgery demanded enucleation and wide destructive bone surgery but this was deemed inadvisable. The patient was referred to the Cutler Tumor Clinic for opinion as to the value of x ray therapy and advised that surgery offered only possible relief.

The patient, aged seventy years and free of pain, wisely refused further surgery This case has been discussed in detail to emphasize the evident fact that the early



Fig. 394 Case I malignancy: carcinoma. *a*, Original condition *b* extent of the excision *c* and *d* correction of ectropion and Stage 1 in the repair of the lateral and alar loss, *e* rotated flap lined with ear cartilage and skin sutured in the nasal defect *f* blepharoplasty (See p. 582 for detailed discussion of this procedure.)

nasal lesion, wisely managed, offered almost certain clinical cure, and, further that this late surgery accomplished its purpose in providing several years of comfort and acceptable contact with her social environment.

Case II. The patient presented in Figure 395 *a* *b* (p. 584) is sixty five years old. The ulcerative dissecting lesion in the midlobule was biopsied and subsequently treated by x radiation eighteen months before this examination and surgery The pathological report was squamous cell carcinoma, grade II.

The large lobule and the dependent tip permitted a wide excision (Fig. 395 *c*)

and closure with an acceptable cosmetic result. See Figure 364 (p. 539) for similar treatment of a traumatic lesion.

The immediate and final results are presented in Figure 395 *d e f g*

A metastatic carcinoma, grade III was excised from the right cheek fourteen months later No further clinical evidence of malignancy has been noted during five years.



Fig. 395 Case II carcinoma. *a* and *b* The original condition, *c* enlarged photograph of the excised lesion *d* and *e* the immediate repair *f* and *g* the result of this procedure. (See p. 583 for detail.)

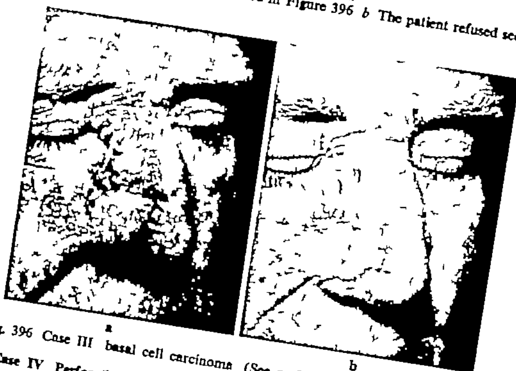
Case III. (Basal Cell Carcinoma). This patient, aged fifty-eight, presented a raised, indurated mass 3/8 inch (1 cm.) in diameter 3/16 inch (0.5 cm.) above the nostril margin. There was no evidence of involvement of the nostril lining.

Procedure A rectangular excision was made, 7/8 by 1/2 inch (2 by 13 mm.) of the mass and its borders, including all tissue to the nostril lining. A flap, based on the cheek lateral to the excision, was elevated from the junction of the infra-orbital and nasal skin as high as the inner canthus, rotated and sutured in the defect (Fig 396,

a) The cheek skin was elevated, advanced and approximated to the nasal skin with 00000 Dermalon sutures.

The pathological report was basal cell carcinoma.

The result a year later is presented in Figure 396 b The patient refused secondary cosmetic repair



a b

Fig. 396 Case III basal cell carcinoma (See p 584 for detail and procedure.)

Case IV Perforating Squamous Cell Carcinoma Involving the Cartilaginous Septum, the Lower and Upper Lateral Cartilages, the Nasal Lining, the Columella and Nasal Floor (Fig. 397 a, p 586) The patient had known of the tumor for six months.

No pharyngeal lateral pharyngeal or cervical glands were discoverable. A chest x-ray study was negative.

The columella with part of the approximating lip the entire superior and high lateral lining and the entire cartilaginous and part of the bony septum were excised (Fig. 397 a b) and the nose was relined with split skin.

Procedure STAGE 1 A cap splint supporting a central bit of square tubing to receive an intranasal splint was cemented on the teeth.

The involved tissue with wide borders was excised en masse (see Fig. 397 a) The raw surface—skin covering—and the nasal floor were covered with split skin. This was covered with gauze impregnated with scarlet red ointment, and contact was maintained with lightly packed ribbon gauze. The skin circulation was such that this was deemed safer temporarily than an intranasal splint. The packing was removed on the seventh day and replaced with the splint.

An interval of six days elapsed.

STAGE 2. TUBING SUPRACLAVICULAR PEDICLE (see p. 17 General Considerations)

An interval of six weeks elapsed

STAGE 3 DELAY OF PEDICLE.

An interval of three weeks elapsed before the next stage.

STAGE 4 DELAY OF PEDICLE.

An interval of two weeks elapsed before the next stage.

STAGE 5 TRANSFER OF THE DISTAL END OF THE TUBE TO THE NECK AREA BENEATH THE ANGLE OF THE MANDIBLE (Fig. 397 b)

An interval of three weeks elapsed before the next stage.

STAGE 6 TRANSFER OF THE MESIAL END OF THE TUBE TO THE NASAL TIP (Fig. 397 c)



Fig. 397 Case IV perforating carcinoma involving the septum, lower cartilages, nasal lining, the columella and the floor *a* Excised nasal and lip lesion *1* septum *2* lateral crus of lower cartilage *3* tumor *4* columella and lip *5* triangular cartilage *6* nasal floor *b* Dental cap splint supporting skin graft on the nasal covering supraclavicular skin tube for repair *c* caterpillared tube for columella construction. *d* and *e* Result of procedure. (See p. 585 for detail of construction.)

An interval of six weeks elapsed before the next stage.

STAGE 7 AMPUTATION OF THE TUBE, ADJUSTMENT OF THE COLUMELLA IN THE LIP. REPAIR OF THE BASE IN THE NECK.

Figure 397 *d e* presents the result seven years after this surgery

Benign Tumors

Rhinophyma

This is a condition that occurs almost exclusively in males at middle life There are, however, occasional female examples of this pathology

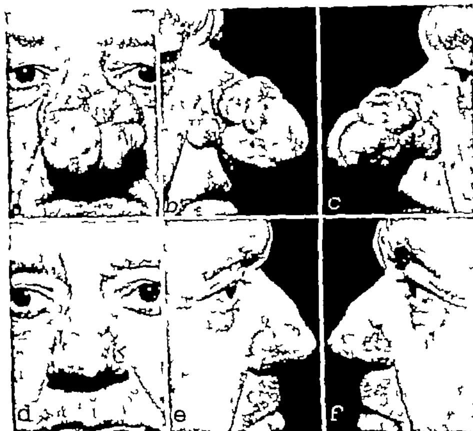


Fig. 398 Rhinophyma. *a b* and *c*, The initial condition *d e* and *f* result of this procedure.

(see Fig. 399, p 588) It usually involves part or all of the lobule (lower half) and rarely the rolled margin of the nostril. The pathological condition may approach this margin and roll it posteriorly to produce the appearance of destruction

It is a hypertrophic acne producing soft, purplish nodular masses separated by deep fissures. In rare instances the condition extends beyond the cartilages to the lining mucosa. It is characterized by dilated blood vessels, increased activity and hypertrophy of sebaceous glands and chronic inflammation with hypertrophy of the connective tissue and covering skin

The disease is best treated by excision This may be accomplished by dissection of the mass, if its size location and surrounding covering skin permit closure Good result has been obtained over a long period by shaving with a razor until the epithelium at the bottom of the lesion is reached. Regeneration of this epithelium well controlled, rapidly covers the shaved area



Fig. 399 Rhinophyma. (See p. 587 for detailed discussion.)

Control the bleeding with hot saline packs, dry and apply a saturated solution of tannic acid Cover for one day with a loose dressing to absorb serum, and then leave it exposed to the air The tannic crust resulting from albuminous coagulation and so on is maintained. This is generally separated and the epithelization complete at the end of two weeks.

An unusual involvement is presented before and after this management in Figure 398 (p 587) The operated area may be completely covered with normal bordering skin by advancing the normal lateral nasal and infra-orbital skin (see Rhinoplasty p 534 or Multiple Excision p 341)

CONGENITAL DEFORMITIES AND DISABILITIES

Developmental deficiencies and malpositions result in marked cosmetic disabilities and in some of these conditions varying functional

disturbances or obstructions. Examples of both circumstances and methods of correction are presented in the following cases.

Case I Retraction of Nasal Base and Lip ("Dish Face") The deformity resulting from deficiency of those parts of the maxillae which form the foundation for the lip and cartilaginous base of the nose may vary from an unsightly condition to one that is hideous The change in the profile is most striking.

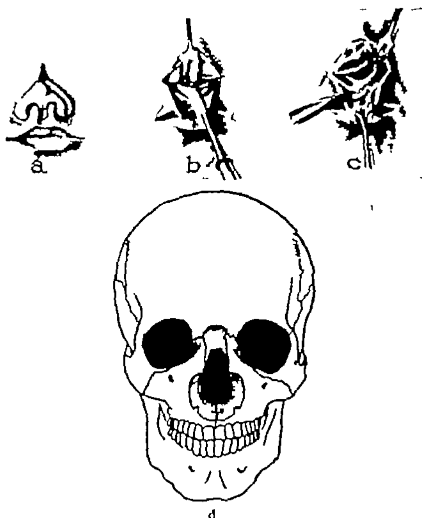


Fig. 400 Case I retraction of nasal base and lip (dish face) *a*, Coughlin's incision for elevation of the tip and columella *b* separation of tissue from the bony floor and nasal spine *c* insertion of shaped cartilage about the pyriform opening; *d* skull, with location of shaped costal cartilage about the pyriform opening.

It is characterized by retraction of the entire basal base—alae, tip and columella—to a bony foundation that lies posterior to its normal plane The alae are collapsed the columella is short, thick, and drawn posteriorly and the upper lip is drawn posteriorly along its junction with the nose to produce an appearance of increased length.

The condition may be congenital, it may be consequent upon a loss

from trauma or disease, or it may be the result of the repair of a cleft palate and lip

Correction may be accomplished by one of two procedures, or a combination of both Either the abnormal maxillae may be built up to the



Fig. 401 Dish face a, Before operation b costal cartilage has been planted about the pyriform orifice after the plan of Coughlin. The columella has been lengthened. The ridge and columella have been supported by costal cartilage (See p. 589 for detailed discussion.)

normal plane or the soft parts may be readjusted The determination of management will vary with each case Orthodontia is of signal service in young patients

Coughlin describes a good method of supplementing the bony foundation by implantation of costal cartilage An incision pictured in Figure 400 is carried through the soft parts to the bone The tissues are

retracted in both directions and freed from the nasal spine and adjacent nasal floor Costal cartilage shaped as shown in Figure 166 and with the perichondrium intact on its under surface, is fixed about the borders of the pyriform opening. The excised wedges of cartilage permit shaping. The soft parts are drawn together by strong catgut relaxation sutures and the skin is closed.

The same result is partially obtained by enlarging the fornix with Thiersch grafts and fitting a proper prosthesis

Blair describes a method of readjusting the soft parts which is satisfactory in properly selected cases.

An incision is carried from the first molar tooth on one side to its fellow on the opposite side It should be so placed that sufficient tissue remains attached to the jaw to offer a good abutment for suturing later in the repair

The soft parts—cheeks, lip and nose—are freely elevated An incision is carried upward through the membranous septum along the inferior edge of the quadrilateral cartilage and the skin over the lower half of the nose is elevated.

Strong relaxation sutures placed deep in the soft parts draw the cheeks toward the middle line and force the lip and nose into prominence. The mucosa of the cheek flap is advanced one interdental space toward the median line in suturing. This is carried on from either side and applies to each suture placed.

The tip of the nose may be elevated 3 to 5 mm by placing orthopedic stitches through the fixed septum and columellar soft parts (Figs. 378 and 400 *a* pp 566, 589)

Short Columella and Membranous Septum, Maldevelopment of the Septal Cartilage; Flat Nose. The shortness of the columella (¼ inch—0.5 cm) and membranous septum anchors the tip and adjacent covering skin The developing quadrilateral cartilage is limited in anterior expansion and bends—becomes convex—between the covering skin and the vomer, and dislocates The resultant blocking of the airways and the small nostrils interferes markedly with respiration. The retracted upper lip, the flat nose and distorted dorsal ridge form a striking cosmetic disability (Fig. 402 *a b* p 592)

Procedure The columella and membranous septum may be lengthened by either of two methods. These structures may be incised horizontally along the floor of the nose and the incision carried upward along the inferior margin of the cartilage to free them The defect resulting from elevation is corrected with an ear lobe graft (see p 514) The second procedure Gensoul's (see p 507) was used

STAGE I LENGTHENING OF COLUMELLA AND MEMBRANOUS SEPTUM, SEPTUM RECONSTRUCTION Incise the membranous septum from the dorsal ridge (anterior edge of the quadrilateral cartilage) to the floor along the inferior edge of the cartilage. Carry the incision 2 or 3 mm laterally on the floor on both sides. Curve these incisions forward around

the columellar base and down the philtrum mesial to its border folds for the required distance

Proceed as discussed under Gensoul s Operation (p 507) and Septum Reconstruction (p 577)

An interval of six weeks elapses

STAGE 2, RHINOPLASTY BONE GRAFT Make alar incisions elevate the covering skin and excise the nasal bone and process to create a glabellar curve as discussed under Rhinoplasty (p 560) The width



Fig. 402 Short columella and membranous septum maldevelopment of the septal cartilage; flat nose. *a* *b* and *c* The original condition *d* and *e* the result of the procedure. (See p 590 for detailed discussion.)

of the bony arch is satisfactory in this case and does not need any interference.

Procure, shape and implant an ilial cancellous bone graft as discussed on page 41

The result of this procedure is acceptable and is presented in Figure 402, *d* *e* The only objection to doing the Gensoul procedure in the male is the possible transference of hair bearing skin to the lower columella and distortion of the philtrum

Congenital Anomalies of the Nose: *Axial Divisions and Formations*

The causes of congenital maldevelopments of the type under consideration are not known and appear to vary with individual cases

Axial clefts in the external and internal nasal structure occur in varying degrees, and are frequently associated with clefts in the lip, alveolar process, palate and bordering bony structure. Facial asymmetries and widespread orbital location are not infrequent accompani-

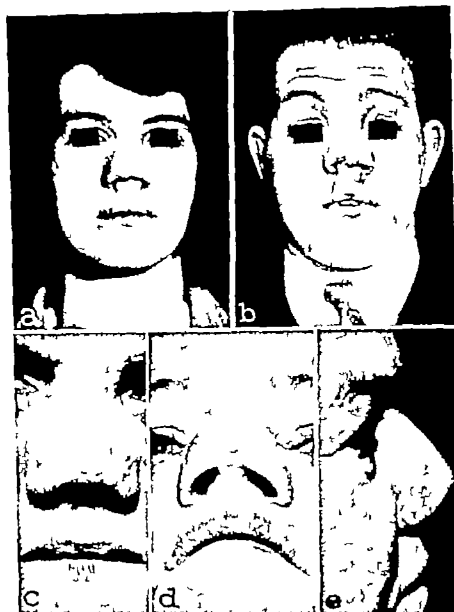


Fig. 403 Example of congenital anomaly with axial maldevelopment. *a* and *b* Similar columellar nasal and lip maldevelopments, *c d* and *e* the result of the correction of the condition seen in *a*. (See p. 592 for detailed discussion.)

ments (see Figs. 403–407) Some appear to be related to fissures and centers which in early embryonic life are associated with facial and sensory organ development. It does not seem possible to prove that these clefts are mere failures of fusion it is more probable that normal development was reduced or inhibited at some stage or damaged in

some manner They appear to have grown in a stage seen in the early weeks of embryonic development.

Case I. The case presented here is that of an infant aged eight months. This child, a five year old brother and the parents were unusually well developed. The infant had a normal skull, jaws, palate and face except a moderate depression of the right infra-orbital area. There was normal structure of all elements of the left nose and sinuses, the septum, two nasal bones and a small right frontonasal process of the maxilla. The columella was short and attached to the right of the philtrum. The right nose, per se, was absent. There was no cavity on this side of the septum (Fig. 405 *a*, p 595) no maxillary antrum and no ethmoid labyrinth, but there was a small circular dehiscence replacing the infundibulum (Fig. 405 *a*)



Fig. 404 Example of congenital anomaly with axial divisions and formations. (See p. 592 for detail)

The soft tissues of the external right nose were present and were represented by a tubular structure attached to and hanging from the soft tissues above the canthus and over a frontal infundibular bone dehiscence.

X-ray showed a definite asymmetry of the floor and infundibulum of the two frontal sinuses. There was an apparent dehiscence of the floor on the right side (Fig. 405 *a*)

This tube was ¾ inch (2 cm.) in diameter There was a normal nostril on its distal end, closed at the mucocutaneous junction by a membrane perforated in the top of the nostril (Fig. 405 *b*) by the end of a tract extending the length of the tube and apparently draining tears.

There was, apparently neither cartilage nor bone in this tube It contained innervated muscle which contracted when the infant cried. Tears, apparently ran from the nostril.

X ray study of the tube after injection of lipiodol into the nostril opening revealed a short dilated tract extending upward about one quarter of the length of the tube The fine tear duct connected with this tract (see x ray Fig. 406 *a*)

Procedure There was sufficient evidence of the presence of a lacrimal sac and rudimentary nasal duct to make their preservation and function a basic consideration in the plan of the reconstruction of an external right nose. The normal nostril demanded its retention without any interference with its shape and general structure.

The x ray evidence of the lack of any nasal passage through the maxilla, and so forth, the absence of any intranasal structures and the absence of some of the accessory sinuses precluded, properly any consideration of a right nasal passage. The left one was normal and adequate under the circumstances.

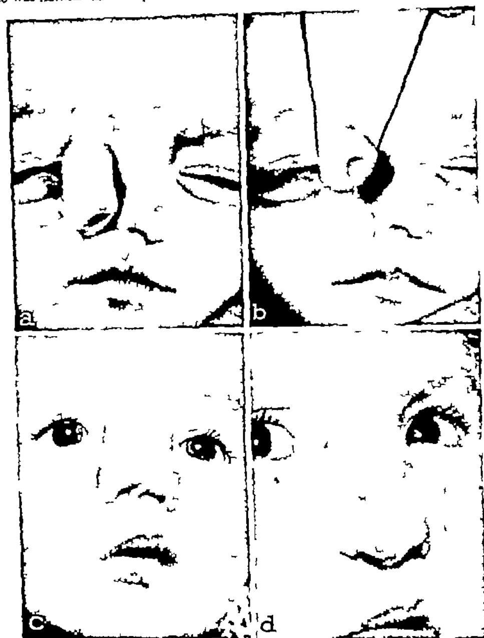


Fig. 405 Case I congenital developmental anomaly *a* and *b* absence of the right nose per se, no cavity on right side of septum, no maxillary antrum the soft tissues of the right nose are hanging from the soft tissues superior to a frontal infundibular bone dehiscence; the tube contains normal nostril and a tract which drains tears, no cartilage or bone. *c* and *d* The result of the reconstruction. (See p. 594 for detailed description and procedure.)

Any chiselling of a passage through the bone and subsequent skin grafting to maintain it may be spectacular but totally useless. The physiological function of this upper third of the respiratory tract—regulation of the flow and warmth of in-

spired air the cleansing function of the mucous carpet and ciliated cells and the lubrication of mucosa of the area—cannot be duplicated with a skin lining. There are no sinuses to ventilate.

Consequently the plan consisted in producing a nasal shape approaching the normal which would maintain a functioning lacrimal apparatus and restore the contour of the infra-orbital area.

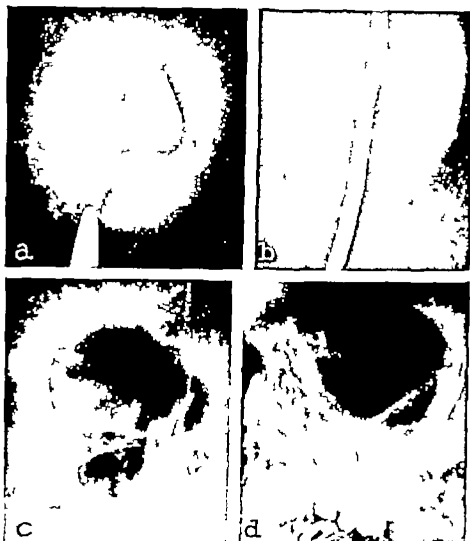


Fig. 406. X ray study *a* Opaque oil in the nostril, a tract running to a dilatation which extends through an apparent tear duct to the lacrimal sac. *b* Probe in the nostril opening through a tract to the lacrimal sac. *c* Dehiscence in the infundibulum marked Y *compare with the same area in d. d The normal lacrimal fossa.* Brother and sister have congenital prolabial and nasal maldevelopment. The brother has ptosis and wide alae with no columellar development. (See p. 594 for detailed discussion.)

Arey says that the nasolacrimal duct arises in 12 mm. embryos as a ridgelike thickening of the epithelial lining of the nasolacrimal groove. This groove extends from the inner angle of the eye to the primitive olfactory fossa, and separates the maxillary and lateral nasal processes of that side. The lumen of the ducts and so on is not completed until birth.

STAGE 1 An incision was made from the mesial side of the inner canthus along the line that would normally mark the junction of the nasal and infra-orbital skin to and around the ala for its inferior attachment.

The skin was dissected mesially and the attachment of the columella to the lip was incised This permitted elevation of the left nose and tip to its proper position.

An incision was made along the midline of the posterior surface of the tube from a point near its attachment to ⅜ inch (1 cm.) above the nostril border (Fig. 405 *a*



Fig. 407 Case II congenital anomaly: failure of the development of the right nose There is no bone development of the nasal process, nasal bone or cavity nor ethmoid cells on the right side no maxillary sinus development. (See p. 592 for technical discussion.)

p. 595) and carried from this point at right angles around the tube for one half of its diameter A second parallel incision just superior to the rolled nostril margin was made mesially and connected with the one above so that this flap of skin covered the defect resulting from raising the tip and shifting the columella.

The margin of the dissected skin was sutured with 00000 Dermalon lateral to the longitudinal incision to the incised infra-orbital skin. The small flap was sutured on the columella.

The *skin was dissected only* on the mesial side of the longitudinal incision to the limit of the incision around the distal end of the tube.

An incision was made from the superior end of the longitudinal incision mesially to the anterior surface. This end of the flap was carefully dissected away from the lacrimal sac and so forth and sutured to the elevated nasal skin (Fig. 405 c)

An interval of three months elapsed (age one year)

STAGE 2. ADJUSTMENT OF EXCESS TUBE AND CONTENT The longitudinal scar was incised on the nasal dorsum. The skin was elevated, laterally A probe was inserted *in the nasolacrimal tract, and the excess connective tissue content of the tube was* dissected. The connective tissue covering of the duct about the probe was freed. The duct was anchored with two or three 00000 plain catgut sutures near the middorsal line. The excess covering skin was excised and sutured with 00000 Dermalon in the midline. This produced normal width in the midportion of the nose (Fig. 405 *d*)

An interval of eighteenth months elapsed.

STAGE 3 CORRECTION OF CONTRACTED GLABELLAR SCAR CARTILAGE COLUMELLAR AND RIDGE SUPPORT The curved glabellar scar was incised around the attachment of the right nose. A parallel incision was made in the frontal glabellar scalp and the included mesial skin flap elevated. The skin elevation was continued over the left glabellar area. This flap was drawn laterally to the right, and the excess lateral margin excised and sutured with 00000 Dermalon (Fig. 405 *d*)

The horizontal scar was incised at the nasal tip The dorsal skin was elevated and the columellar skin separated A carved, preserved cartilage support was inserted in the dorsal ridge and columella, and sutured.

An interval of two weeks elapsed.

STAGE 4 CARTILAGE IN RIGHT LATERAL WALL. The scar along the midarea of the lobule was incised. The skin over the right lateral nose was elevated. A thin plate of cartilage was introduced to provide the support of the upper lateral cartilage. Suture was made and a dressing applied with moderate pressure.

An interval of eight months elapsed.

STAGE 5 DERMAL INLAY IN THE INFRA-ORBITAL AREA The lateral scar was incised *for ½ inch (1 cm.) above the ala. The skin was elevated over the* 1 inch (2.5 cm.) depression lateral to the nose and inferior to the orbital margin. A dermal inlay taken from the abdomen was implanted (see Dermal Graft, p. 135) Suture was made and a dressing applied with moderate pressure

The result of these procedures is presented in Figure 405 *d*. The cosmetic scar corrections, establishment of the final dorsal level, contour and so forth have been deferred until full development of the left nasal bone nasofrontal process and septum has occurred. The patient is now ten and a half years old. This contour is to be obtained with a cancellous ilial bone graft based on the nasal bone and process.

HEMANGIOMA

See Hemangioma (p 234) for the general discussion and manage

or both (Fig. 408 *e*) This is nearly ready for correction with a dermal inlay The patient is now ten and a half years old.

Procedure The lesion was 1 inch (2.5 cm) in diameter It involved the entire lower half of the nose from the pyriform margin to the base of the columella, except the latter halves of the alae.



Fig. 408. Case I hemangioma. *a* and *b* The original condition. *c* The condition after sclerosis with radon seeds outline of original multiple excision. *d* and *e* Result of the procedure (See p 598 for details and procedure.)

STAGE 1 The circular lesion was divided into quadrants with a pen. A dot was punctured with a needle and dye on each quadrant line 1 cm. from the periphery The surface was prepared.

A 20 millicurie radon seed was inserted to a depth of about 6 to 8 mm. at each dotted point. An interval of six months elapsed

The *skin was dissected only* on the mesial side of the longitudinal incision to the limit of the incision around the distal end of the tube.

An incision was made from the superior end of the longitudinal incision mesially to the anterior surface. This end of the flap was carefully dissected away from the lacrimal sac and so forth, and sutured to the elevated nasal skin (Fig. 405 *c*)

An interval of three months elapsed (age one year)

STAGE 2. ADJUSTMENT OF EXCESS TUBE AND CONTENT The longitudinal scar was incised on the nasal dorsum. The skin was elevated, laterally A probe was inserted in the nasolacrimal tract, and the excess connective tissue content of the tube was dissected. The connective tissue covering of the duct about the probe was freed. The duct was anchored with two or three 00000 plain catgut sutures near the middorsal line. The excess covering skin was excised and sutured with 00000 Dermalon in the midline. This produced normal width in the midportion of the nose (Fig. 405 *d*)

An interval of eighteenth months elapsed.

STAGE 3 CORRECTION OF CONTRACTED GLABELLAR SCAR, CARTILAGE COLUMELLAR AND RIDGE SUPPORT The curved glabellar scar was incised around the attachment of the right nose. A parallel incision was made in the frontal glabellar scalp and the included mesial skin flap elevated. The skin elevation was continued over the left glabellar area. This flap was drawn laterally to the right, and the excess lateral margin excised and sutured with 00000 Dermalon (Fig. 405 *d*)

The horizontal scar was incised at the nasal tip The dorsal skin was elevated and the columellar skin separated A carved, preserved cartilage support was inserted in the dorsal ridge and columella, and sutured.

An interval of two weeks elapsed.

STAGE 4 CARTILAGE IN RIGHT LATERAL WALL. The scar along the midarea of the lobule was incised. The skin over the right lateral nose was elevated. A thin plate of cartilage was introduced to provide the support of the upper lateral cartilage. Suture was made and a dressing applied with moderate pressure.

An interval of eight months elapsed

STAGE 5 DERMAL INLAY IN THE INTRA-ORBITAL AREA. The lateral scar was incised for ½ inch (1 cm.) above the ala. The skin was elevated over the 1 inch (2.5 cm.) depression lateral to the nose and inferior to the orbital margin. A dermal inlay taken from the abdomen was implanted (see Dermal Graft, p. 135) Suture was made and a dressing applied with moderate pressure

The result of these procedures is presented in Figure 405 *d*. The cosmetic scar corrections, establishment of the final dorsal level, contour and so forth have been deferred until full development of the left nasal bone, nasofrontal process and septum has occurred. The patient is now ten and a half years old. This contour is *to be obtained with a cancellous iliac bone graft based on the nasal bone and process.*

HEMANGIOMA

See Hemangioma (p 234) for the general discussion and management.

or both (Fig. 408 *e*) This is nearly ready for correction with a dermal inlay The patient is now ten and a half years old.

Procedure The lesion was 1 inch (2.5 cm.) in diameter It involved the entire lower half of the nose from the pyriform margin to the base of the columella, except the latter halves of the alae.



Fig. 408 Case I hemangioma. *a* and *b* The original condition. *c* The condition after sclerosis with radon seeds, outline of original multiple excision. *d* and *e* Result of the procedure (See p 598 for details and procedure.)

STAGE 1 The circular lesion was divided into quadrants with a pen. A dot was punctured with a needle and dye on each quadrant line 1 cm. from the periphery The surface was prepared.

A 20 millicurie radon seed was inserted to a depth of about 6 to 8 mm. at each dotted point. An interval of six months elapsed.

The *skin was dissected only* on the mesial side of the longitudinal incision to the limit of the incision around the distal end of the tube.

An incision was made from the superior end *of the longitudinal incision mesially* to the anterior surface. This end of the flap was carefully dissected away from the lacrimal sac and so forth, and sutured to the elevated nasal skin (Fig. 405 *c*)

An interval of three months elapsed (age one year)

STAGE 2 ADJUSTMENT OF EXCESS TUBE AND CONTENT The longitudinal scar was incised on the nasal dorsum. The skin was elevated, laterally A probe was inserted in the nasolacrimal tract, and the excess connective tissue content of the tube was dissected. The connective tissue covering of the duct about the probe was freed. The duct was anchored with two or three 00000 plain catgut sutures near the middorsal line. The excess covering skin was excised and sutured with 00000 Dermalon in the midline. This produced normal width in the midportion of the nose (Fig. 405 *d*)

An interval of eighteenth months elapsed.

STAGE 3 CORRECTION OF CONTRACTED GLABELLAR SCAR, CARTILAGE COLUMELLAR AND RIDGE SUPPORT The curved glabellar scar was incised around the attachment of the right nose. A parallel incision was made in the frontal glabellar scalp and the included mesial skin flap elevated. The skin elevation was continued over the left glabellar area. This flap was drawn laterally to the right, and the excess lateral margin excised and sutured with 00000 Dermalon (Fig. 405 *d*)

The horizontal scar was incised at the nasal tip The dorsal skin was elevated and the columellar skin separated. A carved, preserved cartilage support was inserted in the dorsal ridge and columella, and sutured.

An interval of two weeks elapsed.

STAGE 4 CARTILAGE IN RIGHT LATERAL WALL. The scar along the midarea of the lobule was incised. The skin over the right lateral nose was elevated. A thin plate of cartilage was introduced to provide the support of the upper lateral cartilage. Suture was made and a dressing applied with moderate pressure.

An interval of eight months elapsed.

STAGE 5 DERMAL INLAY IN THE INFRA-ORBITAL AREA. The lateral scar was incised for ½ inch (1 cm.) above the ala. The skin was elevated over the 1 inch (2.5 cm.) depression lateral to the nose and inferior to the orbital margin A dermal inlay taken from the abdomen was implanted (see Dermal Graft, p 135) Suture was made and a dressing applied with moderate pressure

The result of these procedures is presented in Figure 405 *d* The cosmetic scar corrections, establishment of the final dorsal level, contour and so forth have been deferred until full development of the left nasal bone, nasofrontal process and septum has occurred. The patient is now ten and a half years old. This contour is to be obtained with a cancellous ilial bone graft based on the nasal bone and process.

HEMANGIOMA

See Hemangioma (p 234) for the general discussion and management.

Case I. The problem presented here has some special considerations. The child was fifteen months old. Surgical treatment, ligation and excision would have *necessitated skin from a distance to reconstruct the lower third or perhaps, half of the nose.* This would have created unnecessary cosmetic disabilities on either the forehead or face, if the texture and color of the nasal skin were matched. Further it could not afford so fine a cosmetic result as local management.

The *obliteration—sclerosis—of* the cavernous and capillary lesion with resulting surface scar may be accomplished with either interstitial radiation—radon seeds—or a sclerosing chemical such as 5 per cent sodium morrhuate

The former was chosen, even at the risk of retardation or inhibition of the septal and lateral cartilage development. The plan contemplated multiple excision of the resultant scar drawing the lateral nasal and facial skin onto the area to replace the skin scar and to leave only a fine linear approximation scar A saddle of the lower dorsal ridge resulted from either the pressure effect of the condition, the radiation,

or both (Fig. 408, *e*) This is nearly ready for correction with a dermal inlay The patient is now ten and a half years old.

Procedure The lesion was 1 inch (2.5 cm.) in diameter It involved the entire lower half of the nose from the pyriform margin to the base of the columella, except the latter halves of the alae



Fig. 408 Case I hemangioma. *a* and *b* The original condition, *c* The condition after sclerosis with radon seeds outline of original multiple excision. *d* and *e* Result of the procedure (See p 598 for details and procedure.)

STAGE I The circular lesion was divided into quadrants with a pen. A dot was punctured with a needle and dye *on each quadrant line 1 cm*, from the periphery The surface was prepared.

A 20 millicurie radon seed was inserted to a depth of about 6 to 8 mm. at each dotted point. An interval of six months elapsed.

STAGE 2. IMPLANTATION OF RADON SEEDS. The skin color except for three capillaries, had disappeared at the end of ten weeks. The *mass* was *materially reduced*, but remained fluctuant.

The lesion was divided into quadrants which subdivided the original points. Radon seeds were inserted as in Stage 1

An interval of seven months elapsed.

STAGE 3 EXCISION OF REDUNDANT SKIN AND SCLEROSED SUBCUTANEOUS MASS. A median elliptical skin incision was made from the upper border to the lower scar border on the tip The scarred skin was elevated to its lateral borders. The sclerosed subcutaneous tissue was removed. The incised borders of skin were overlapped under tension. The excess skin was excised and sutured. The nose was dressed with a surface splint to control form during healing. The result of these procedures after six years is presented in Figure 408 *c* (p. 599) The dotted lines map the plan of the next stage of multiple excision of this scar

An interval of six years elapsed

STAGE 4 SCAR EXCISION. A median skin incision and lateral curved incision were made in the scar near the normal skin border as outlined in Figure 408 *c* (p 599) *The central incision was carried upward about 5 mm. in the normal skin*. The skin was elevated on the dorsum, lateral nasal walls and for about 1 cm. in the infraorbital area.

This *scar and the skin were rotated mesially and downward in the direction of* the dotted line on the ala.

The excess was excised and sutured.

This *procedure* was *repeated* at the end of six months and again after four months to produce the result presented in Figure 408 *d e* The child is now approaching the age when the permanent dorsal ridge may be constructed with dermal inlay in the saddle of the septal cartilage.

Case II. This female infant weighed four pounds at birth and nine pounds at the time of the picture presented in Figure 409 *a* (p. 601) See result in Figure 408 *d e* page 599

She presented a congenital cleft and cavernous hemangioma of the entire upper lip and bordering cheeks, a cavernous hemangioma of the nose excepting the lateral halves of the alae and the glabellar area above the internal canthi, and an absence of the columella, the tip the mesial third of the left ala and the inferior border of the quadrilateral cartilage.

The situation is an ideal example of the surgeon s responsibility in planning as well as in execution *There is both a marked functional and cosmetic disability* The child's social, economic and psychic future could be ruined with the orthodox procedures. It is possible to accomplish an acceptable reconstruction by utilizing the *local and bordering tissues without facial* and frontal scarring.

The lesion must be obliterated—sclerosed. An acceptable *lip* must be constructed first to serve as the foundation or base of the nasal reconstruction. The scar surface skin must provide nasal lining and carry normal skin on its superior and lateral borders for construction of a columella, a tip and the rolled borders of the defective nostrils. The graft-covered surface of the nose must be replaced ultimately with normal bordering skin, leaving only fine linear scar

Such procedure is neither immediately spectacular nor accomplished in a brief period of time It does however permit the surgeon to discharge fully his responsibility thereby adding greatly to the future comfort and efficiency of the patient

Procedure STAGE 1 INTRODUCTION OF RADON SEEDS SCLEROSING OF LESIONS. The nose lesion was diagrammed and radon implanted as in Case 1 (p. 598) Radon seeds were placed in the lips 1 cm. from the cleft borders and a similar distance *apart from the alae to the free borders.*

An interval of nine months elapsed.

STAGE 2. ADDED RADON SEEDS. There was marked reduction of the lesion in both areas, but fluctuation was still present in the nose and both lateral lips.

Two radon seeds were implanted in the nose on a vertical line mesial to the alar attachment of each lip, as in Case 1 (p. 598)

An interval of six months elapsed.

STAGE 3 LIP RECONSTRUCTION. The result of the radiation is presented in Figure 409 *b*. An incision *AB* was made through the skin in the sulcus of the alar cheek attachment and along this line in the scar over the alar lip attachment, and

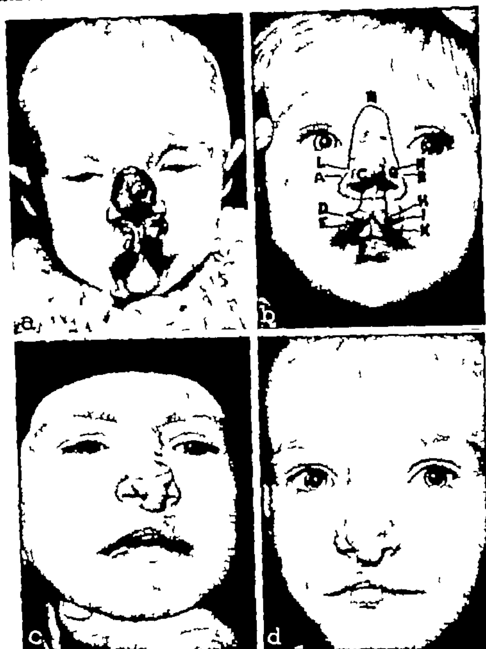


Fig. 409 Case II cavernous hemangioma of the nose and lip. *a* The condition at birth *b* the result of sclerosis of the lesion with radon seeds, and the outline and plan of reconstruction (see p. 600 for details of the procedure and significance of the lettering) *c* the result of the lip reconstruction and the nose reconstruction as described in Stage 6 (p. 603) *d* further stage of the nasal construction.

along the median line below the nasal spine to and around the left ala in a similar manner

A vertical incision was made through the full thickness of the right lip, beginning at the lateral border of the scar in the nostril line *C* and continuing downward to about the junction of the middle and lower thirds of the lip. This incision was

curved laterally into the normal lip to the point D which is approximately one third of the lip length from the mucocutaneous line (E). An incision was made through the vermilion border at a right angle to its cutaneous junction (EF).

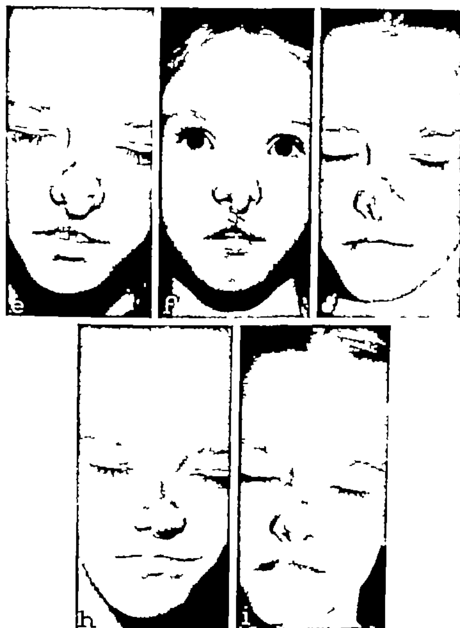


Fig. 409 (continued). *e, f* and *g*. Further nasal reconstruction and multiple excision; a Z plastic to correct the notch in the constructed lip is outlined in *f*. *h* and *i*. Completion of the multiple excision and the result of the procedure. (See p. 600 for details of the procedure.)

A vertical incision was made through the left lip beginning at the lateral border of the scar in the nostril line (G) and continuing downward to the point H equal to the length of the incision ending at C on the right side and located the length of DE from the lateral scar border (the line HI). An incision was made from I across the vermilion border at a right angle to its cutaneous border.

The scar was excised mesial to these three incisions.

The skin and mucosa were split from the muscle and scar 2 mm. along the incised edges *CD* and *GHI*

The alar attachments were incised through the buccal sulcus and along the nasal floors and the pyriform margins. The alae and bordering cheek tissues were elevated.

Silk Lane sutures (00) were passed beneath the skin about ¼ inch (0.5 cm.) above *D* and below *C* through the muscle and buccal mucosa about ⅜ inch (1 cm.) from the margin and then back through the mucosa about ⅛ inch (3 mm.) from its incised edge. The other end of the suture was passed in a similar manner above and below *G* and *H*. This vertical mattress suture approximated the muscle borders and slightly everted the approximating mucosal edges.

The rectangular flap, *DEF* was approximated to *HIK* with two 00000 plain catgut sutures passed through the muscular layers.

The mucosa was approximated with a few fine silk sutures.

The scarred skin on the left lip between the lines *AB* and *GHI* and the normal skin laterally on the cheek was elevated and incised at the scar border. The normal skin was advanced mesially and approximated to the skin edge *CD* with interrupted 00000 Dermalon sutures. The scarred skin below the line *IK* and the vermilion border was similarly treated. The abutting vermilion surfaces were sutured with 00000 Dermalon.

The result is presented in Figure 409 *c* (p. 601)

An interval of four months elapsed.

STAGE 4 NASAL RECONSTRUCTION An inverted U-shaped flap, indicated by the dotted line *LMN* (Fig. 409 *g* p. 602) was incised through the skin and sutured and delayed. The plan was to use this flap hinged on its base along the residual nostril borders, as the lining of the nasal reconstruction its columella and the rolled edges of the alar defects.

STAGE 5 DELAY OF FLAP The scar borders were incised, and the flap elevated as far as the circulation would permit and sutured in its bed.

STAGE 6 ROTATION OF FLAP COLUMELLAR AND ALAR CONSTRUCTION The scar borders were incised and the flap elevated to about 3 mm. above the nostril borders, folded inferiorly 180 degrees (hinged on the nasal margins) and the distal end sutured with 00000 plain catgut for the columella and the rolled edges of the alar defects (Fig. 409 *c*)

The columella was sutured in its normal lip location with 00000 Dermalon. The nasal defect was grafted with thick, split skin.

Iodoform packs were placed in the nostrils for shape and support (Rhinoplasty see p. 566) The nose was covered with two or three layers of gauze impregnated with scarlet red ointment. An eye pad and fluffed gauze were applied with moderate pressure. The result is presented in Figure 409 *c*

An interval of two years elapsed.

STAGE 7 Z PLASTIC FOR LIP RETRACTION The general scar contraction had spoiled the vermilion border line, which demanded central lengthening. This was accomplished by a Z plastic with flaps incised through the entire lip (See Fig. 409 *e* p. 602, and the result in subsequent pictures.)

An interval of eight months elapsed.

STAGE 8 MULTIPLE EXCISION OF THE GRAFT A transverse incision was made across the upper margins of the alae and the lateral borders of the graft (Fig. 409 *f*) The bordering normal skin on the nose and cheek was elevated freely. The approximation line over the graft was determined by mesial traction from both sides. The excess graft was excised and sutured with 00000 Dermalon. The result is pictured in Figure 409 *g*

An interval of fourteen months elapsed.

STAGE 9 TEMPORARY CARTILAGE SUPPORT IN RIDGE AND COLUMELLA The shaping of the dorsum and columella demanded some temporary support or foundation. The transverse scar was incised along the superior borders of the alae. The skin

of the dorsum was elevated, and that of the columella separated down to the nasal spine. A shaped cartilage was implanted in the dorsum, and a post in the columella which was fixed to the dorsal piece with plain 00000 catgut. The wound was sutured and dressed with a splint (Fig. 409 *h*)

An interval of six months elapsed.

STAGE 10 FINAL MULTIPLE EXCISION ADJUSTMENT OF THE ALAE AND COLUMELLA. The excision procedure is the same as that discussed in Stage 8 The result with stitches in place is presented in Figure 409 *i*.

The columella was incised from tip to base on its lateral borders and sutured to the septal mucosa. The alar and tip reconstructions were adjusted.

An interval of six years elapsed.

STAGE 11 DERMAL GRAFT IN LOWER DORSAL SADDLE.

CYSTS: SEBACEOUS AND DERMOID

Sebaceous Cysts

Ninety per cent of all sebaceous glands accompany hair follicles. In this location they are associated with sweat glands as well as the hair follicle They occur also independently in the nostrils, eyelids and arms

A cyst of such a gland usually results from a congenital occlusion of its duct, but this may occur later from a local pathological condition.

The case presented in Figure 410 (p 605) is an example of the former type

Case I. *Procedure* The entire cyst sac must be excised It is obvious that this can be accomplished easier and perhaps, with more certainty by external incision and reflection of a covering flap This however does not discharge the cosmetic responsibility of the surgeon The cyst may be completely removed by an intranasal incision 3 or 4 mm superior to the nostril margin by elevation of the covering skin as in rhinoplasty and blunt dissection of the sac from the cartilage lining layer

An example of a neglected cyst is presented in Figure 410 (p 605) The residual redundant skin should adjust with the nasal development.

Dermoid Cysts

Congenital dermoids are readily connected with embryonal fissures junctures and clefts. The nasomaxillary cleft appears to be a failure of development of early embryonic structures Several types of congenital nasal deformities (see p 592) bear out this belief The nasal septum occurs with double plates or lamellae and so forth This affords opportunity for inclusions of ectoderm and bordering developing tissues. Dermoid cysts occur in such septums They also occur higher in the median line either beneath nasal bones which have developed or in the area with failure of bony development and fusion They penetrate the skull near the median line and may grow deeply pushing the pia mater ahead of the stalk They frequently present difficult clinical and pathological problems They may undergo malignant change

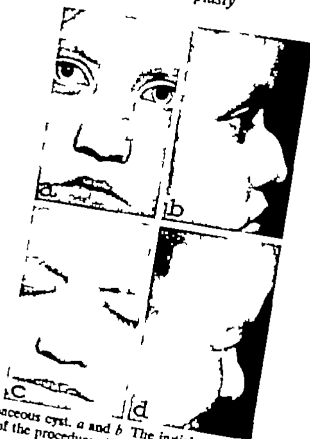
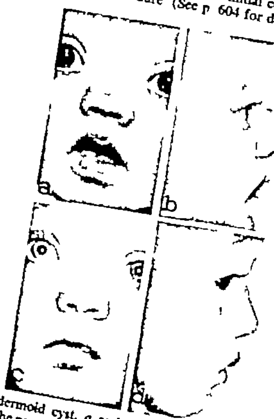


Fig. 410. Case I sebaceous cyst. *a* and *b* The initial condition *c* and *d* the result of the procedure (See p 604 for details.)



411 Case II dermoid cyst. *a* and *b* The original condition *c* and *d* the result of the procedure. (See p. 606 for details of procedure.)

Case II. An infant, aged six weeks, had a small round mass in the midline above the tip of the nose. The mass gradually increased to the size of ½ inch (1.5

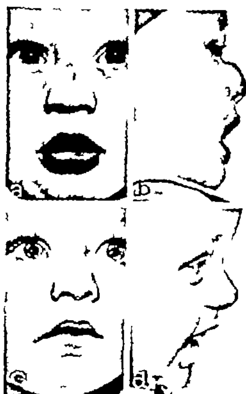


Fig. 412. Case III dermoid cyst. *a* and *b* The original condition *c* and *d* the result of the procedure. (See p. 607 for details of the procedure.)

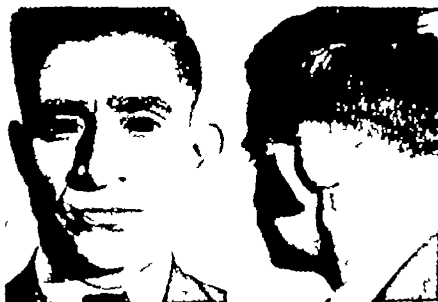


Fig. 413 Case IV retro-oral dermoid cyst. This is introduced to emphasize the wide distribution of dermoid cysts.

cm.) in diameter at the age of four months (Fig. 411 *a* *b* p. 605). Note the moderate lateral spreading of the orbits, the internal canthi were ⅝ inch (1.5 cm.) apart.

Procedure A linear incision was carried from the pyriform margin to the lower border of the cyst in the tip The cyst was separated laterally and inferiorly A tract extended superiorly under two nasal bones. A lateral part of a nasal bone and the articulating margin of the nasal process were removed with a rongeur forceps. The tract was followed through the frontal floor It terminated on the pia mater over the frontal lobe just lateral to the midline

The pathologist s report was benign dermoid cyst.

There was drainage of cerebrospinal fluid.

The tract was lightly packed with petrolatum ribbon gauze and the wound partially closed Fluid drainage ceased after several days. The tract was dressed with a gauze drain and allowed to granulate.

Fig. 411 *c d* (p. 605) presents the development of the bony bridge and nose at the age of eighteen months.

Case III. An infant, aged fourteen months, had a small rounded mass, first noticed at the margin of the nasal bones. This increased rapidly to the size (⅜ inch —1 cm.) and distribution presented in Figure 412, *a, b* (p. 606)

Procedure An elliptical incision was made on one side of the mass, the covering skin flap elevated, the cyst aspirated and the sac completely removed. There was no tract beyond the sac border

The incision was sutured with 00000 Dermalon, the nose covered with an eye pad, and a metal splint applied (see p 126 Fig. 89) The result several weeks later is presented in Figure 412 *c d*

PROSTHESIS

The prosthetic substitution for partial or total nasal losses has definite marked values psychically socially and economically The prosthesis may be so constructed, fitted and tinted as to become practically nonevident to the casual observer Neither of the examples presented later has that quality One was made by its professional owner and the other is not sufficiently thinned and applied around its borders, but is otherwise excellent.

A prosthesis greatly improves and maintains morale in the traumatic case pending final reconstruction, this is particularly true for the malignant cases during the long period before reconstructive surgery may be safely begun. It is occasionally a desirable permanent substitution in burned patients who have no useful skin on the forehead face or neck and who prefer this repair to the cosmetic effect of skin from distant body areas it is not only greatly desirable but is the prerogative of the patient with the fungating ulcerating mass resulting from neglect or bad treatment and who, otherwise has no possibility of clinical cure Such a patient is given months of comfort continued social contacts and a much preferable conclusion of the invasion

Two illustrative malignant cases are presented.

Case I Fungating, Ulcerating, Squamous Cell Carcinoma Grade II with Parotid, Cervical and Thoracic Metastasis. This patient was a dentist who invented and contributed much to small x-ray equipment. He treated a self-diagnosed maxillary sinus condition with low voltage radiation for many months. A lesion developing on the left nose was removed in this manner A high voltage treatment elsewhere removed the left nasal wall Cauterization and surgery followed with the result presented in Figure 414 *b c* (p 608) at the time of this examination. The lesion seen in Figure 414 *a* was the condition at the termination of his personal treatment weeks earlier

The right nasal bone was sequestering the left retained periosteum covered with granulation tissue Cartilaginous septum was destroyed, and there were ulcerative

lesions on the margin of the bony remnant. There was an ulcerating, fungating tumor 1½ inches by 1 inch (4 by 2.5 cm.) in the right infra-orbital area. There was a gland mass in the parotid, numerous cervical glands to the clavicle level, pulmonary metastasis, and so forth.

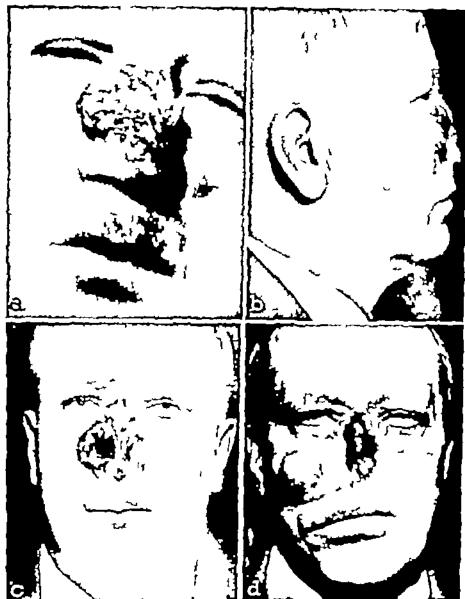


Fig. 414 Case I fungating, ulcerating, squamous cell carcinoma with metastasis. *a* The original condition *b* and *c* result of high voltage x ray *d* stage 1 of the reconstruction.

Procedure STAGE 1 The lesion and its bordering bone were radically removed in the usual manner A rectangular flap base lateral to the excision border was elevated from the right cheek and neck, rotated, and approximated to the excision borders (Fig. 414 *d*) Healing occurred without incident.

An interval of one month elapsed.

STAGE 2 EXCISION OF ROTATION FULLNESS OF FLAP The patient preferred to make his own prosthesis (Fig. 414 *f* p. 609)

The condition seven months after excision of the mass is presented in Figure 414 *e* The parotid mass was beginning to cause pain. It was treated satisfactorily with x-ray There was slow enlargement of the submaxillary and cervical metastases.

The patient expired as a result of hemorrhage twenty-one months after excision of the parotid tumor elsewhere.

Case II. Squamous-Cell Carcinoma, Grade II. The patient, aged fifty had had a right facial lupus repaired by cheek flaps at age eighteen. A small lesion which developed on the left lateral nose was treated by x radiation for many months with extensive loss and scarring.

The surface scar on the nose was repaired with a rotated forehead flap which necrosed The nasal bed and borders of the flap presented recurrent, invading malignancy The patient had further x-ray radiation and, finally a prosthesis which could not be worn because of recurrent evidence of malignancy

The patient's appearance at the time of this examination is presented in Figure

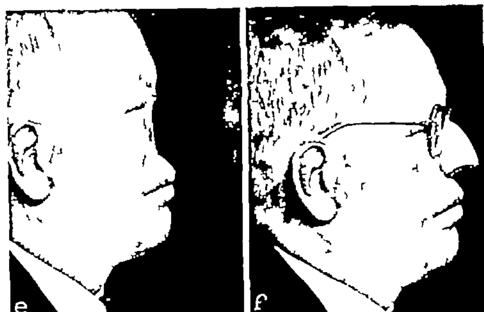


Fig. 414 (continued) *e* Healed condition metastatic parotid mass. *f* Prosthesis. (See p 607 for detailed discussion.)

415 *a b c* (p. 610) The left antrum was clear and the right opaque. The right intranasal appearance was negative. The external ulcerative lesion on this side began at the level of the inner canthus and extended downward to the margin of the ala, and laterally to an indurated border down the midinfra-orbital area. This induration continued laterally in this area. The tip of the nose mesial quarter of the ala and columellar skin were absent on the left side.

A scar running from the margin of the right mandible around the corner of the mouth upward and mesially to the nose outlined the early flap repair of a lupus. The infra-orbital area of the left cheek was atrophied and scarred by x radiation.

X ray study of the bordering bone was negative.

Procedure STAGE 1 The ulcerative area was widely excised down to the bone and the right antrum investigated through the canine fossa. The right ethmoid labyrinth was exenterated. The nasal processes and bones and part of the septum were excised, and so forth. The pathologist's report was squamous cell carcinoma, grade II.

The lateral flaps were elevated on the cheeks and approximated with the nasal lining along the bone borders. The healed result is seen in Figure 415 *d e f*

An interval of fifteen months elapsed.

STAGE 2. BIOPSY OF NODULE IN FRONTAL DUCT A mass in a slitlike cell in the duct wall was widely excised. The area was covered with an advanced flap from above the eyebrow

Two years had elapsed since the nasal excision. The biopsy of seven months previous deferred any surgical reconstruction for many months. The patient recently presented a large mass over the left sternomastoid muscle which promptly subsided

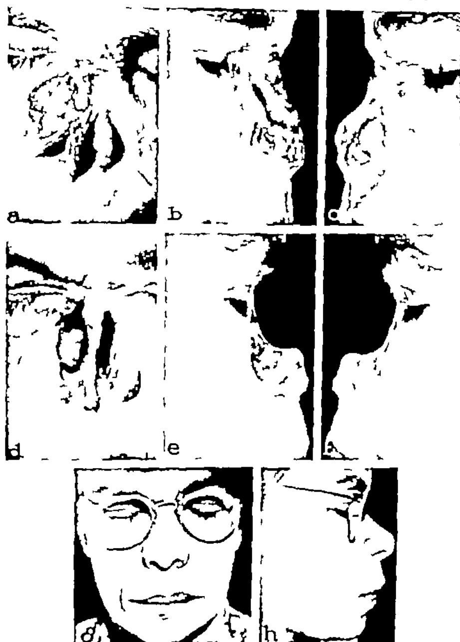


Fig. 415 Case II squamous cell carcinoma following lupus x radiation and surgery *a b* and *c* The original condition *d e* and *f* the condition after radical excision and repair *g* and *h*, the prosthetic appliance (See p 609 for detailed discussion and procedure)

under x-radiation. The nature of this mass was not known but its character and behavior suggested an inflammatory process.

The patient was comfortable and presentable with a latex prosthesis which is excellent except for its approximating borders, which could be thinned to fit smoothly (See Fig. 415 *g h* for present condition and prosthesis.)

Chapter X

CHEILOPLASTY

SIMPLE SUTURE

The skin is dissected from the underlying fascia and muscle for a short distance around the entire border of the wound

Vertical mattress sutures of silk (noncapillary) relax and approximate the muscle and the mucosa The lowest suture is passed first. The needle is inserted about ½ inch (about 1 3 cm) from the mucosal border (Fig. 416 *top B*) and carried through the muscle *to the skin* (Fig. 416 *top A*) to emerge at the edge of the wound It is reintroduced between the skin and the muscle on the opposite side of the wound and passed through the muscle and mucosa to a point about ½ inch from the margin of the wound. It is then passed diagonally through the mucosa to the free margin of the wound and finally through the mucosa on the first side A second and a third stitch are passed in a similar manner The stitches are tied sufficiently tight to approximate accurately the cut muscular surfaces The skin is closed with *interrupted horsehair sutures* or a *subcuticular stitch* The former are removed on the second day and the line of incision is supported with *gauze collodion strips* (Figs. 135 137)

This suture is not desirable in cleft lip reconstruction which uses the Hagedorn technic The flaps are too small to support such a suture Further it is unnecessary if the lip attachments have been properly incised and separated. A suture of 00000 plain catgut, rather loosely tied is sufficient (see p 660)

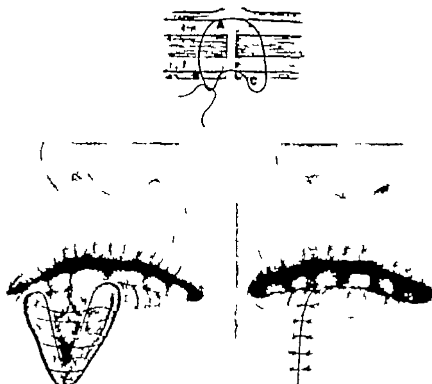


Fig. 416 Repair of defect of lower lip *Left* Disposition of the relaxing and approximating sutures. *Top* Detail of the suture *A* skin *B* mucous membrane *C* vertical mattress suture. This suture produces the desired relaxation and approximation of the muscular layers and the mucous membrane It also everts the edges of the mucosa. It prevents cutaneous scar by permitting early removal of cutaneous sutures. *Right* The skin approximated with horsehair sutures.

ELEVATION AND DEPRESSION OF ANGLE OF MOUTH

Tissue Loss and Deformity Skin and superficial fascia scar and contraction (Fig. 417)

Requirements. Removal of scar tissue, introduction of sufficient skin and subcuticular tissue to repair the defect

Procedure. This correction is accomplished in a single procedure The elevation or depression of the angle above or below its normal plane determines the width of the interpolated flap required (Fig. 417 *c B*) The length of the flap is determined somewhat by the degree of the elevation or depression

Elevation of Angle of Mouth To correct elevation of the angle of the mouth make a curved incision beginning near the midpoint of the lip Carry it along the mucocutaneous border of the upper lip to the commissure around the commissure and along the mucocutaneous border of the lower lip for a sufficient distance to produce a flap of the required length. Carry it downward for the desired width and laterally to complete the outline of the flap and also that of its base

Dissect the skin and underlying fat of the flap Dissect the elevated angle of the mouth free from the surrounding scar Remove the scar tissue in the area Transpose this part of the mouth and the flap Close



Fig. 417 Correction of elevation of the angle of the mouth by means of an interpolated flap. *a* Third and fourth degree burn destruction of the skin of the eyelids with resultant ectropion scar contracture distorting the mouth. *b* Appearance after restoration of the angle of the mouth to its normal position, thick split skin graft covering the granulated area and the eyelids. *c* Outline of an incision to free the tissues about the angle of the mouth *A* and to produce a suitable flap, *B* for transposition. *d* Transposition of mouth tissues and the flap simple suture. (*a* and *b* from Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

the approximating edges with interrupted horsehair sutures. Paint the stitch line about the mouth with compound tincture of benzoin Cover the stitch line of the lip with a gauze dressing moist with alcohol.

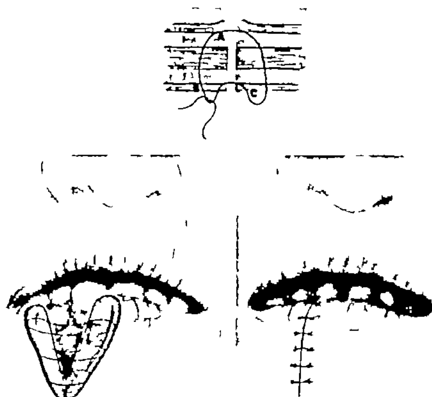


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Dissect the skin and underlying fat of the flap Dissect the elevated angle of the mouth free from the surrounding scar Remove the scar tissue in the area. Transpose this part of the mouth and the flap Close



Fig. 417 Correction of elevation of the angle of the mouth by means of an interpolated flap. *a*, Third and fourth degree burn destruction of the skin of the eyelids with resultant ectropion scar contracture distorting the mouth. *b* Appearance after restoration of the angle of the mouth to its normal position thick split skin graft covering the granulated area and the eyelids. *c* Outline of an incision to free the tissues about the angle of the mouth, *A* and to produce a suitable flap, *B* for transposition *d* Transposition of mouth tissues and the flap simple suture. (*a* and *b* from Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

the approximating edges with interrupted horsehair sutures Paint the stitch line about the mouth with compound tincture of benzoin Cover the stitch line of the lip with a gauze dressing moist with alcohol.

Depression of Angle of Mouth Correction of depression of the angle of the mouth may be accomplished by the transposed flap procedure pictured in Figure 417 It is simply a reversal of what is shown in that figure.

Figure 418 depicts another simple method of correction which utilizes the tissues about the angle of the mouth as the transposed flap

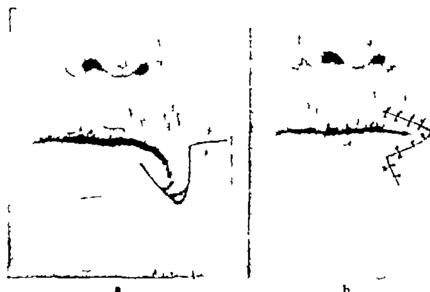


Fig. 418 *a* Depression of the angle of the mouth. Outline of a suitable flap for its correction *b* transposition of flap and angle of mouth suture

ECTROPION OF LIP

Ectropion of the lip is a distortion (eversion) resulting from loss of tissue and formation of scar with ultimate organization and contraction The loss may be superficial or deep It may be submental and cervical (Fig 419 *upper*) it may occur about the margin of the lip (Fig. 419 *lower left*) or it may involve the tissues of the entire lip (Fig. 419 *lower right*) A combination of these various losses is pictured in Figure 420

This distortion is preventable to a large degree by proper management at the time of injury the appropriate treatment of burns, including grafting at the proper time the thorough débridement and immediate approximation of lining and skin covering in the case of full thickness losses or immediate repair when this is possible

See Cervicoplasty (p 666) for the reconstruction

The constant, powerful traction by a scar everts, distorts and permanently stretches the mucosa, making it difficult in some instances to return the buccal mucosa to its normal location Some degree of intra-oral correction is required frequently to maintain the border of the lip in its normal position (Fig. 419 *lower right* Fig 420) The traction by scar prevents development of bone in some instances (Fig

420 see also Fig. 454) It occasions loss by pressure atrophy in other instances. It may distort the existing bone as can be seen from the position of the teeth in Figure 419 *upper*



Fig. 419 Ectropion. *Upper* The result of destructive scarring and contraction in the submental and cervical regions note that traction of the scar has distorted the mental region of the jaw and everted the two central teeth. *Lower left above* Simple ectropion due to tissue loss and scar contraction along the mucocutaneous junction. *Lower left below* Correction with an interpolated flap from the cheek. *Lower right* Total ectropion resulting from destruction of the skin of the lower lip and subsequent scar contraction.

The *requirements* for support and cosmetic result may be any or all of the elements of the lip skin, supporting tissue lining, bone or

cartilage or both bone and cartilage. It is desirable that the required tissues be obtained from the locality rather than introduced from a distance. Transplanted skin, either as free graft or as pedicled flap presents contrasts in color so frequently that it is undesirable. It may however become a necessary choice.

OBLITERATION OF CHIN AND CHIN LINE OF THROAT

Reconstruction in most cases can be effected by utilizing tissues of the locality and dermal grafts (Fig. 420)

Loss. Skin and superficial fascia of lower lip face and neck

Requirements. Release of contraction caused by scar and removal of scar addition of skin to release the mucosa and elevate it to its proper level readjustment of the cervical skin to produce a chin line supporting tissue placed in the mental region to produce a chin correction of the depressed angles of the mouth.

Procedure. *Stage 1* Incise the scar around the mucosa of the lower lip Dissect the mucosa up to the level of the angles of the mouth Excise about 1 inch (about 2.5 cm.) of the free border of the mucosa This has been stretched until it presents an excess too great for adjustment.

The normal vermilion border may be preserved in many instances. This is desirable because of the difference of the physiological character of this and the buccal mucosa.

Parallel incisions along its border are made from near one angle of the mouth to the other the double pedicled flap is elevated, the scar dissected from the lip to return it beneath the flap to its normal position and the rotated covering skin flap sutured at the desired horizontal level The vermilion flap is then placed in its normal position the excess mucosa excised and the flap sutured.

Incise elevate and rotate a flap of proper dimensions from the left cheek and neck to fill the defect on the lower lip (see also Fig. 435 *c d e* which represents repair of an upper lip) Suture the approximating edges with interrupted stitches of horsehair Undercut the skin bordering the defect resulting from elevation of the flap and approximate with interrupted horsehair sutures.

Stage 2 The minimal interval between Stages 1 and 2 is six weeks The purpose in Stage 2 is reconstruction of the neck

This management of the neck deformity is described here for the sake of emphasis (see Cervicoplasty p 666)

Design Z flaps with the central member of the Z dividing the elevated scar in the midline of the neck from a point just below the chin to a point midway to the clavicle The lateral arms of this Z are projected at angles of 60 degrees (p 221) Dissect the included flaps, the scar and the subcutaneous tissues surrounding the bases of these flaps Transpose the flaps and stitch the approximating edges with interrupted sutures The transposition of these flaps and the traction laterally partially reproduce the normal chin neck line Remove all sutures except

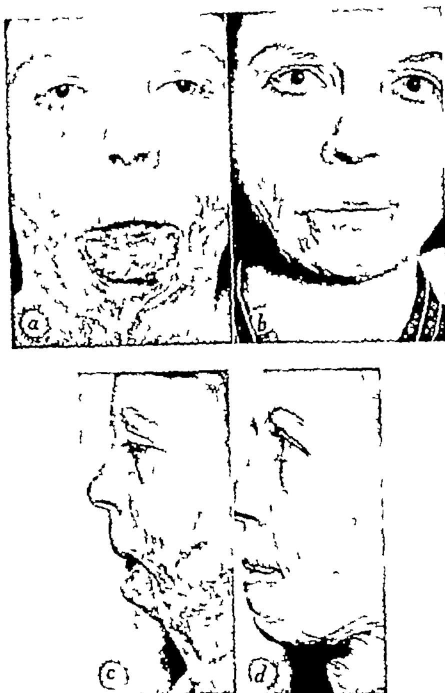


Fig. 420 *a* and *c* Total ectropion of the lower lip partial fixation of the head atrophy of the mental portion of the mandible obliteration of the chin and neck line as the result of traction by scar *b* and *d* Result following Z plastic operations on the neck interpolated skin flaps on the lower lip intra-oral excision of excessive mucosa implantation of shaped cartilage and dermal grafts in the mental region the patient has base powder on the skin in these final pictures. The scar in the right cheek may be removed by multiple excision.

those at the angles of the transposed flaps on the second day and support with strips of gauze applied with collodion.

The interval between Stages 2 and 3 is six weeks.

Stage 3 Neck Reconstruction Repeat the procedure described in Stage 2. Increase the lateral pull of the two flaps to correct further the neck line and to eliminate some of the scar tissues on the lateral borders and distal ends of the flaps (see Multiple Excision, p 341)

The interval between Stages 3 and 4 is three weeks.

Stage 4 Dermal Chin Graft Make 1 inch (2.5 cm.) incisions, centering beneath each angle of the mouth, in the scar line beneath the mandible Dissect the subcutaneous tissue of the chin and lip area between the two incisions. Carry the dissection to the buccal sulcus. Dissect a strip of skin 6 inches (about 15 cm) long and 1 inch (2.5 cm) wide from the abdomen. Remove its epithelium Fold it on itself and draw it into the dissected tunnel (see Dermal Graft, p 135) Close the incision with interrupted sutures

An interval of six weeks elapses.

Stage 5 Elevate the depressed angles of the mouth.

Follow the procedure described in the legend of Figure 418 or the reverse of the procedure in Figure 417

MICROSTOMIA

The buccal orifice—the mouth—may be reduced and fixed (Fig. 421) by scarring and contraction following severe burns ulcerations of the skin and muscle and by traumatic loss of the tissues external to the mucosa The labial and buccal mucosa may be involved to the extent of fixing the lips and limiting motion of the jaw It occasionally occurs as a developmental anomaly resulting from excess of normal closure of the primitive mouth slit.

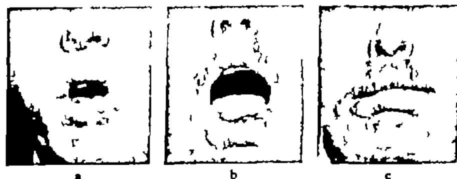


Fig. 421 Microstomia resulting from chemical burn. *a*, Maximal oral opening before reconstruction dense scar replacing the mucosal borders of the lips and the normal tissues about the angles of the mouth. *b* and *c* Result of reconstruction.

In the presence of the conditions mentioned in the first sentence of the preceding paragraph the defect and loss of function can be corrected with the tissue present. In the presence of the conditions men

tioned in the second sentence it is necessary to remove the scar bands and adhesions and to add new epithelial tissue This can be accomplished after opening the mouth by following Waldron s application of Esser s technic for epithelial inlay

Esser Waldron Method. In this procedure the scar bands are incised and released in the buccal sulcus. The borders of the raw surfaces are undercut, and a mold of dental modeling compound is fitted into the resultant cavity This is covered with a thick Thiersch graft applied with the raw surface outward The margins of the wound are sutured and the mold is left in place for eight to ten days The mold is then removed the new skin surface dried in the air and the mold replaced This procedure is repeated daily until organization and contraction are complete The mouth may then be repaired

Werneck Method. A modification of Werneck s operation to utilize small turned-in skin flaps at the commissures produces a satisfactory result (Fig. 422)

The size and shape of the mouth desired are outlined on the skin and the incision is carried through skin and muscle and scar or through skin and scar to the mucosa (Fig. 422 *upper*) The distance between the commissures is exaggerated to allow for subsequent contraction This is further prevented by folding in skin tabs (Fig 422 *upper* and *lower right*) at the angles and suturing these to the buccal mucosa The immediate effect is a square commissure This subsequently is molded by traction of the scar into an acceptable angle The skin can be replaced by mucosa later if it is desirable. The mucosa is trimmed to fit the margins of the lip and is sutured in place with horsehair (Fig. 422)

Microstomia frequently results from scar contraction following reconstruction of a double cleft lip more rarely in the single defect. This is accompanied by the inversion of the vermilion of the lateral parts of the lip and protrusion of the lower one The covering skin hides a normal lip angle which is from ¼ to ⅜ inch (0 5 to 1 cm.) lateral to the functioning opening (Fig 423 p 621) The same disability results from the reconstruction of some burns of the lower lip and adjacent cheeks (Fig. 421 p 618)

This condition is corrected with pleasing result by accurately locating the angles of the mouth outlining a desirable mucocutaneous line and constructing a "cupid s bow" at the bottom of the philtrum as described by Kilner and Gillies (see Secondary Deformity p 621)

The scar formation from surface burns about the lips and cheeks and its subsequent "purse string" contraction and limitation of excursion of the oral orifice create a microstomia The contracted scar and skin covering masks normal mucosal angles lateral to the functioning mouth opening. The correction is the same as in the preceding situation (Fig. 423)

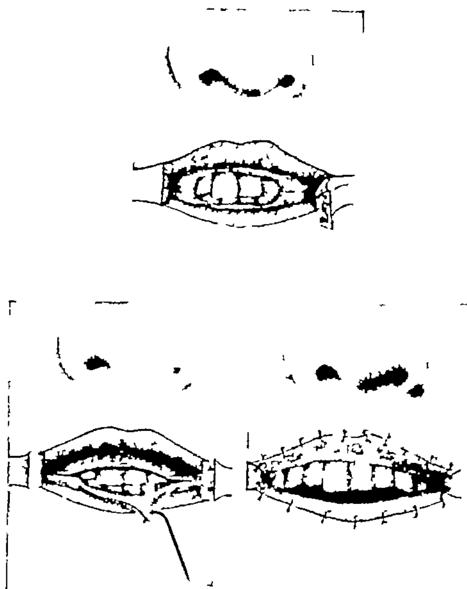


Fig. 422. Microstomia. *Upper* The incision in the skin is carried through the soft parts of the buccal mucosa, and the skin tabs are outlined *lower left* the mucosa is freely undercut and trimmed to cover margins of lips *lower right* the mucosa is sutured to the cutaneous margins with horsehair The skin tabs are folded and sutured to the buccal mucosa.

Microstomia from Surgical Excision and Scar Contraction

Case I. The patient had two operations for the removal of a pigmented nevus which involved the lip from the mucocutaneous border to the lower columella and laterally to the attachment of both alae. The excised area was replaced by cheek skin advanced from both sides.

The marked scarring, contraction of the mouth opening and the distortion of the vermilion are presented in Figure 423 *a* (p. 621)

The requirements are evidently replacement of the scar with normal skin and minimum tension, the reposition of the lip commissures, and the reconstruction of the vermilion

Procedure STAGE 1 Incise the mucocutaneous skin line from one commissure to the other Incise the alar sulcus from its superior cheek origin across the floor of the nose to the same point on the opposite alar sulcus. Incise the median lip scar from the base of the columella to the vermillion border

Elevate the included skin flaps and continue the skin elevation laterally on the cheeks and in the infra-orbital area.

Advance the cheek and infra-orbital skin by sliding, excise the scarred skin, anchor the approximating excised normal borders with subcutaneous sutures of 00 plain catgut and suture the skin edges and so forth with 00000 Dermalon. The result

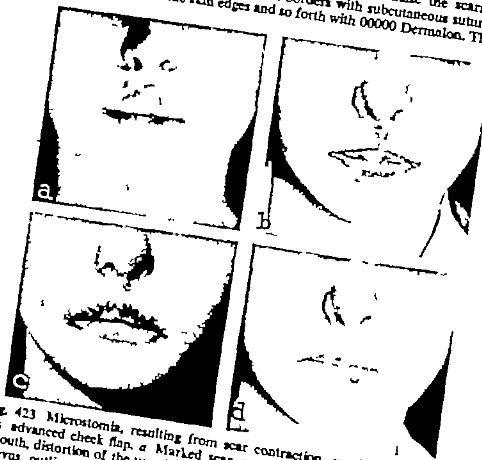


Fig. 423 Microstomia, resulting from scar contraction surgical removal of a nevus advanced cheek flap. *a* Marked scar contraction on the lip, contraction of the mouth, distortion of the vermilion. *b* Result of scar removal and the balance of the nevus outline of reconstruction. *c* Reconstruction. *d* Result of the procedure. (See text for detail of procedure.)

of this procedure is presented in Figure 423 *b* This repair slightly increases the distortion of the lip opening.

An interval of at least six weeks—preferably several weeks longer—elapses to allow for scar organization.

STAGE 2. Determine accurately with a divider the exact position of the commissures. Mark with a needle and dye.

Outline the desirable mucocutaneous line with dye. Design a V-shaped prolongation of philtrum skin into the vermilion to make a "Cupid's bow" after the plan of Gillies and Kilner Incise this line in the skin, except the point of the V attaching to the mucosa. Excise the skin between this incision and the mucous membrane Incise some of the border orbicularis muscle fibers to permit the lip to evert or curl slightly

Suture the skin and mucosa with 00000 Dermalon (Fig. 423 *c*)

The result of this procedure, with marked functional and cosmetic improvement, is presented in Figure 423 *d*

MACROSTOMIA

This large mouth results from persistence of the embryonal horizontal cleft—the mouth slit—in the first branchial arch during the period of formation of the maxilla and the mandible. It usually extends to the masseter muscle and may rarely continue to the tragus. It may

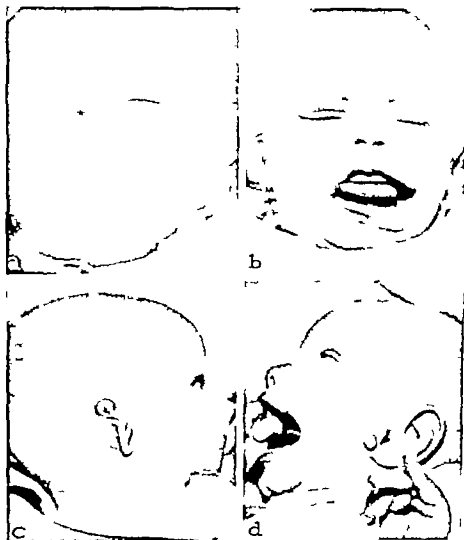


Fig. 424 Congenital macrostomia. *a*, *b* c and *d* The birth condition. (See text for discussion.)

more rarely be bilateral. Further it may be associated with other developmental anomalies An example (Fig. 424) presents a persistent cleft, a microtia on one side and accessory ear cartilages on the side of the cleft.

The correction of the macrostomia is evident. The left commissure —angle—of the lips is determined the buccal mucosa split from the skin and over the free margin of the muscle the skin is similarly in-

cised along the muscle and these three layers are sutured along stag gered lines

REDUNDANT VERMILION BORDER

This is a cosmetic disability which is simply corrected with a striking improvement.

Make an incision through the mucosa from angle to angle in the posterior surface of the upper lip

Elevate the mucosa from the underlying soft tissue and over the free vermilion margin Avoid the labial vessels Remove the excess mucosa. Approximate with 00000 Dermalon sutures (see Fig. 425)



Fig. 425 Redundant vermilion border *a*, The original condition *b* the correction. (See text for discussion.)

STEIN ESTLANDER ABBE OPERATION

This valuable procedure has suffered the same belated recognition of its worth as others which are essential to proper discharge of the surgeon s obligation to the patient. Its basic principle was first described a hundred years ago. The value of the contribution was ignored during periods of popularity of newly proposed destructive technics, or nothing at all was done to correct a crippling cosmetic deformity

The operation, with its added improvements is not properly named. It is the Stein Estlander Abbe procedure Stein a Danish surgeon, described the principle applied to the repair of an extensive lower lip loss in a cancer patient in 1848 Estlander a Finnish surgeon repaired a gangrenous loss of an upper lip with a flap from the lower lip in 1865 and described the procedure in 1872 Abbe an American surgeon was the first to use the lower lip flap in the secondary repair of harelip cases

in 1898 It is in more recent years that the value of this procedure has gained its proper recognition.

The indications for its use are definite The correction of a tight or short upper lip with a protruding lower one or a reversed situation is

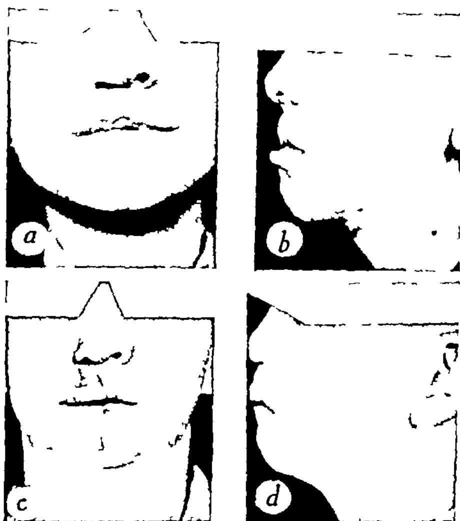


Fig. 426. Stein-Estlander Abbe operation. *a*, Distortion of the ala, tip of the nose and mucocutaneous border of the lip *b* note the tension of the upper lip and the inequality of tissues of the two lips *c* appearance of patient after transposition and organization of a flap from the lower lip *d* appearance of the upper lip after reconstruction compare with *b* (V H Kazanjian.)

its main field of usefulness. There are some cases of short columella on an acceptable lip where it has definite value The author does not believe that it is a method of choice in malignant cases except perhaps, in old, edentulous patients with relaxed mouths which may be well balanced with proper planning A simple V excision with simple closure as described on page 612 produces a perfect result in cases where the lower lip is not abnormally prominent. The procedure is simple and is

concluded in a single operation It permits excisions of a half lip in many cases.

The author does not feel that the removal of a flap from the lateral lip and adjacent cheek is ever a procedure of choice. The surgeon is not

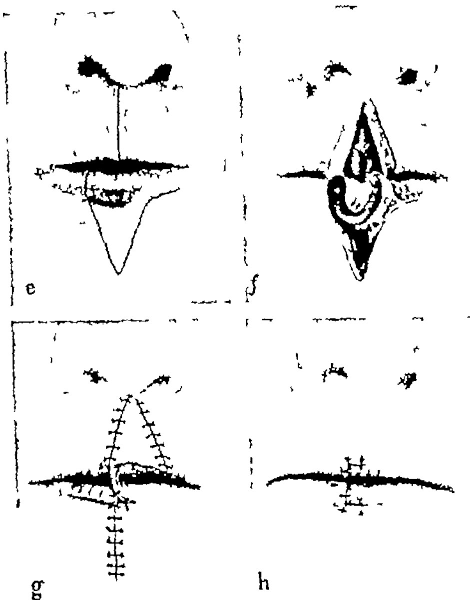


Fig. 426 (continued) Stein-Estlander Abbe operation in diagram. *e* The lines of the incisions through the full thickness of the upper and lower lips. *f* The appearance of the upper lip after section, lower lip flap partially excised. *g* Flap of lower lip sutured into the upper lip pedicle attached. *h*, Excision of the pedicle of flap and adjustment of mucosal borders of lips.

warranted in resecting the muscles of expression and so forth to accomplish a repair which is simply effected with rotated cheek and buccal mucosa flaps without such added disability (see Figs 436 439) A case from the author s service illustrating the objectionable procedure

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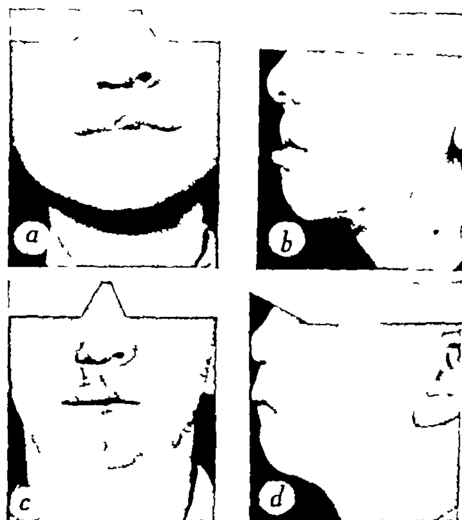


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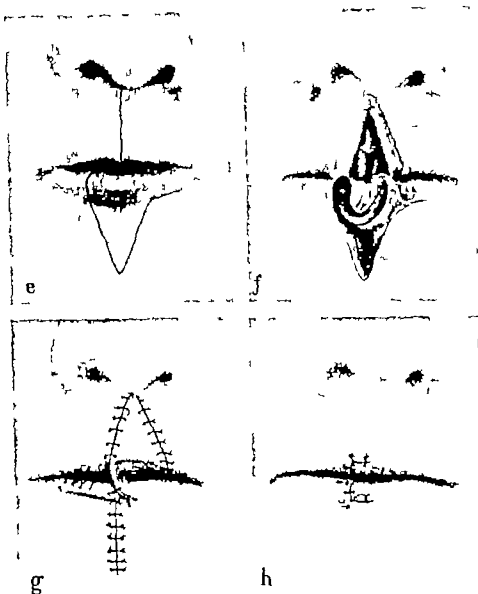


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is presented in Figure 428 This is an edentulous patient eighty years of age with cancer of the lower lip and other disabilities.

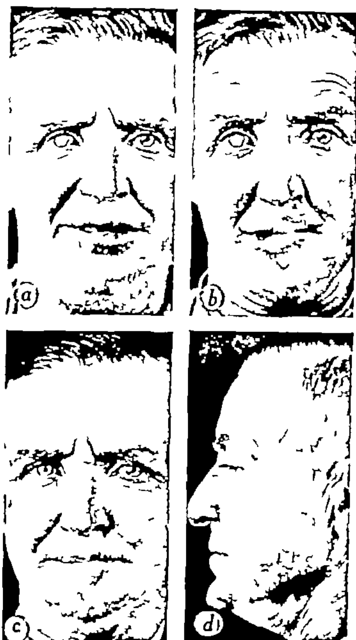


Fig. 427 Stein-Estlander-Abbe operation. *a*, Two epitheliomas of the lower lip excision. *b* Condition after rotating a wedge-shaped pedicle flap from the upper lip into the defect resulting from the excision the pedicle between the two lips has not been cut. *c* Condition after division of pedicle. *d* Profile of the completed result. (Webster)

Procedure *Stage I* Make a median, vertical incision from the base of the columella downward through the free margin of the lip (Fig 426 *e*) Remove all scar The released halves of the lip immediately

assume their proper lateral locations and define the borders of the triangular defect to be repaired (Fig. 426 *f*)

The construction of a balanced mouth requires a careful appraisal of the proportions of the lower lip It is advisable frequently to supply half of the upper defect only from the lower lip in order to maintain balance of the mouth

The measurement of the base of the wedge to be supplied from the lower lip having been determined outline this with its base on the free mucosal border of the lip and its apex in the midline Outline a pedicle to contain branches of the labial artery and to consist of the full thickness of the vermilion border of the lip on its left side (Fig 426 *e*) Carefully avoid injury to the labial artery in the pedicle

Proceed as follows Incise the full lip thickness at a right angle to the surface of the vermilion opposite to the pedicle Carry this incision to the apex of the flap and up to the mucocutaneous border of the pedicle Make the lateral *incisions* along the pedicle *through the skin and mucosa only* Bluntly dissect the muscle containing the artery (Fig 426 *e*) Rotate this wedge and pedicle Split the mucosa and skin from the muscle for 2 or 3 mm from the incised edges Approximate the mucosa and muscle of the defect in the lower lip with vertical mattress sutures of silk (see p 612) Approximate the skin with interrupted sutures of horsehair (Fig. 426 *g*) Rotate the excised wedge into the defect of the upper lip

1 Suture the mucosa of the apex of the wedge to that in the sulcus at the top of the defect.

2 Carefully approximate the mucocutaneous borders of the flap and lip defect. Suture with 00000 Dermalon

3 Suture the mucosa with 00000 plain catgut, then the muscle with similar material and finally the skin and vermilion with 00000 Dermalon The sutures in the latter should be passed through the mucosa only to avoid the artery

Paint the intra-oral suture lines with compound tincture of benzoin, and cover the skin suture lines with gauze moistened with alcohol Apply a Barton bandage and maintain it in place for ten days to two weeks. Feed the patient through either a nasal tube or in the event of missing teeth a tube intra-orally Small rubber tubes may be placed in the angles of the mouth if there is any difficulty in respiration.

An interval of at least two weeks elapses

Amputate the pedicle from the border of the lower lip so as to allow adequate mucosa for completion of the repair of both lips. Make the necessary adjustments and suture the borders with 00000 Dermalon.

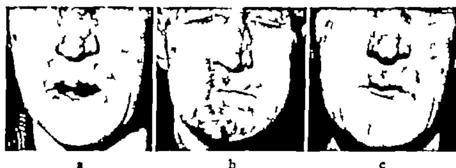
Cannon made a valuable contribution to this procedure in secondary lip repair He designs a rectangular or barrel-shaped flap splits this down the center and uses the arms or halves for repair of the nostril floors and lengthening of the columella, if required

The feeding of these patients should be carefully supervised They should have a high caloric and protein diet.

SECONDARY LIP REPAIR

The deformity which may be well corrected by the following procedures may result from early radiation of various nevi from trauma with loss of substance and scar contraction and most frequently from repair of cleft lip and palate

The latter etiology requires several serious considerations It is probable that the usually generally practiced management of the protuberant premaxilla and the effort to unite it with its bordering alveolar processes inhibits further normal development and results in the lack of lip support and malocclusions seen too frequently in these cases. Further the failure to properly construct a nostril floor position the alar attachment to the columella and correct the distorted lower lateral cartilage with its nasal lining covering results in part of the nasal deformity A misplaced septum and a short columella frequently add to the disability



a b c

Fig. 428 Basal cell carcinoma of the vermilion border of the lower lip of long standing: Stein-Estlander Abbe procedure. *a* Original condition *b* the immediate result of the repair: *c* the final result of the procedure (See p 6 6)

The mandible and lower lip usually develop normally The upper lip does not develop fully It is tense over an underdeveloped arch support it may be the site of a poor surgical repair with marked scar contraction it limits the oral opening and causes the normal lower lip to protrude The inhibited maxillary development causing the malocclusion places the ridge and so forth varying distances behind the lower anterior teeth and frequently results in misplaced teeth over the palatal surface Such cases cannot be properly reconstructed without a suitable dental prosthesis (see Fig. 129 and "Dish Face " Fig. 400 p 590)

There is usually no philtrum because this has not developed, and the prolabium utilized in the initial cleft repair belongs in the columella The vermilion border is distorted

Procedure This varies in some details with the gross condition Racial characteristics or previous nasal trauma and so on may require a total external rhinoplasty The following procedure in the case presented in Figure 429 (p 629) is a typical secondary reconstruction after many double cleft lip repairs

Stage 1 Correction of a Short Columella (Fig 429 *a b*) *Elevation of the Tip Reconstruction of the Lower Lateral Cartilages and the*

Septum (See Columella—Gensoul s Operation—p 507, Rhinoplasty p. 560 and Septum Reconstruction, p 577)

The defect resulting from elevation of the prolabium and excision of bordering skin scar was closed by incising the alar sulcus, the mucocutaneous line, elevating the bordering cheek skin and approximating the skin from the two sides in the median line (Fig. 429 *c d*) This per



Fig. 429 Secondary cleft lip construction for tight lip and short columella Estlander Abbe procedure. *a* and *b* The condition originally c and *d* the result of elevation of the columella and excision of the lip scar by the Gensoul procedure.

mitted, also repositioning the mucocutaneous line resulting in balanced vermilion borders.

An interval of six weeks elapses

Stage 2 Balancing the Two Lips Abbe Flap Incise the scar in the median line of the upper lip from the columella to the free vermilion border (see Fig. 426 *e* p 625) This permits the upper lip to retract to its normal position and determines the base of the rotated flap from the lower lip

Outline incise, rotate and approximate such a flap as described under Abbe procedure (p 626)

An interval of six weeks elapses.

Stage 3 Preparation of an Onlay Supporting Denture (see Fig 129 p 200) There is a marked underdevelopment and shrinkage of the alveolar process and so forth and several teeth are out of position in the palatal roof This denture furnishes the proper support of the upper lip and bears teeth in proper occlusion with the lower ones. Compare Fig

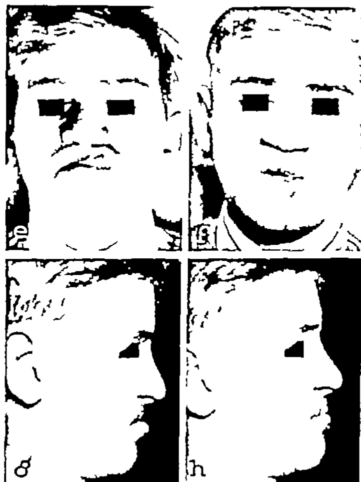


Fig. 429 (continued) e Abbe flap approximated in the upper lip f the result of the procedure g the profile of the reconstructed lip, presenting a normal oral opening with relaxation of the upper lip h profile with an onlay denture restoring proper occlusion. (See p. 628 for detailed description.)

ure 429 *g* without the denture, with Figure 429 *h* with the denture in position Some conditions require the construction of a deeper and wider buccal sulcus to accommodate the denture properly This is accomplished by incising the sulcus, separating the lip and buccal attachments to the desired size covering the denture flange with split skin, raw surface out, and holding this in position by the occlusion of the lower teeth and a Barton bandage This may be removed on the sixth or seventh day the graft cleansed, dried in the air and the prosthesis replaced. This is continued daily until the organization is completed.

An interval of two weeks elapses.

Stage 4 Excision of V-shaped skin covering (Abbe Flap) Adjustment of Lip Skin to a Median Line Scar Excise the V shaped skin covering of the Abbe flap (Fig. 429 *f* p 630)

Incise the left mucocutaneous line

Elevate the lateral lip and bordering cheek skin Approximate it to the bordering incised edge Suture this and the mucosa with 00000 Dermalon

PARTIAL LOSS OF BORDER OF LIP

Small partial losses of the border and substance of the lips can be repaired readily without introduction of new tissue. The result can be accomplished usually by readjustments. This applies particularly to notches in the mucosal border and somewhat greater losses of substance The principles pertaining to sliding and rotated flaps usually meet the requirements with proper planning (p 6)

Vermilion Border This can be obtained in several ways depending on the extent of loss (1) The mucosal lining of the adjusted part of the lip can be advanced by undercutting and sliding (2) The vermilion border of the normal part of the lip can be incised along the mucocutaneous line and freely undercut. This can then be advanced from ⅜ to ½ inch (about 1 to 1.3 cm) depending on the length of this residual part. (3) A flap can be rotated from the bordering cheek. It may be necessary to elevate and delay such a flap until its blood supply has become assured. (4) A tubed flap can be prepared from the buccal mucosa and rotated to attach to an end of the defect, after which the tube can be opened and utilized for the repair

The patient pictured in Figure 430 illustrates some of the methods discussed The loss in this instance resulted from gunshot wound. There were multiple fractures of the mandible loss of bone from the left horizontal ramus loss of the entire left alveolar and palatal processes loss of full thickness of the cheek from the angle of the jaw to the middle of the mouth loss of the vermilion border and much of the adjacent muscle loss of skin of the left half of the upper lip and a torn parotid duct (Stensen s) Subsequently osteomyelitis of the entire mandible developed.

The soft parts presented the condition noted in Figure 430 *a* three months after injury The old scar of the lip was incised to free a flap (*A* in Fig 430) Incision was carried about the left ala of the nose and upward for a short distance in the nasofacial groove The incision was carried laterally intra-orally in the scar covering the loss of the alveolar process to free further the lip and cheek flap An incision was made along the borders of the depressed adherent scar of the cheek, and the adjoining skin was freely undercut. The epithelial surface of the scar was removed, and the skin with its underlying fat, was approximated over this scar base (Fig 147, see also Fig. 202)

The vermilion border of the normal segment was incised from the angle of the mouth to the edge of the defect. The mucosa was freely undercut, and the muscle incised on the free border of this segment to receive the end of the point of the prepared flap (Fig. 430 *b* *B* *C*) This approximation brought the free flap to its proper level The mucosa of the normal segment was advanced laterally to its limit and approximated to the mucosa of the flap which had been undercut and advanced to the cutaneous margin



Fig. 430 Partial loss of border of lip *a*, Loss of mucocutaneous border adjacent full thickness of substance of the lip, and a part of the musculature of the midportion of the lip from a gunshot wound *b* result of the procedure described, together with the significance of letters, in the text.

MALIGNANCY

The location type duration and metastases should determine to a large degree the plan of radical excision the approach to the accompanying removal of involved lymphatics and the relation of these procedures to the final responsibility of functional and cosmetic restoration in the best possible manner

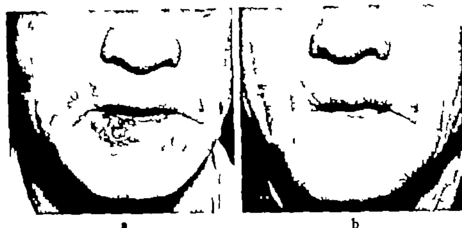
Many lesions involving as much as half of the lip border in certain types of mouths permit adequate local removal and excellent repair with the V type of excision (Fig. 416 p 612, and Case I Fig. 431 p 633) This permits removal of submental and submaxillary glands or block dissection of the cervicals if indicated.

The author has already stated his conviction that the Abbe procedure does not belong to this consideration except in isolated cases (p 623)

Cases of extensive local glandular and general metastases that do not warrant surgery are best treated by local x radiation to destroy the lesion

Cases of extensive lip invasion or those with involvement of bordering structures are well managed in all respects with rotated flaps of skin and mucous membrane and no incision or transposition of bordering musculature (Cases VI VII, VIII IX Figs 436, 437, 438 439, pp 641 643 644, 645)

A case of such extensive involvement of bordering cheek structure as to preclude use of rotated bordering flaps is well managed with tissue



a b

Fig. 431



a b Fig. 433

Fig. 432

Fig. 431 Case I malignancy squamous cell carcinoma with no palpable metastases. The excision and repair *a*, The original condition *b* the healed condition.

Fig. 432. Case II squamous cell carcinoma with cervical and general metastases x-radiation. (See p 634 for detailed discussion of Cases II and III)

Fig. 433 Case III squamous cell carcinoma with general metastases, inoperable x-radiation. (See p. 634 for discussion.)

brought from a distance on a tubed pedicle. Skin from the lower neck is the choice but essential block dissection of this area may make this procedure impossible (Fig. 441 p 649)

Case I Squamous Cell Carcinoma Involving One Third of the Right Vermilion Border and Adjacent Skin. There are no objective *submental* or submaxillary glands (Fig. 431 *a*)

Procedure Removal by a wide V excision as described on page 612 and illustrated in Figure 416 (p 612)

This is an edentulous patient with a relaxed mouth. The result pre

sented in Figure 431 *b* shows a slightly narrowed well-balanced mouth

Case II Squamous Cell Carcinoma of Long Duration and Extensive Local Invasion. There are marked left submaxillary and cervical metastases to the clavicle and general metastases (Fig. 432, *a* *b* p 633)

Procedure Destruction of the local lesion by x radiation The general situation contraindicates cervical and other radiation

Case III Squamous Cell Carcinoma with Extensive Buccal Invasion and General Metastases. The procedure is the same as in Case II

LARGE PARTIAL AND TOTAL LOSS OF LIP

Any plan for the reconstruction of a large partial or total loss of either the upper or lower lip should include and be limited to those procedures which conserve all the muscular function present about the borders and improve the function These rather than cosmetic, considerations should govern the surgeon The final *appearance* however should have all the consideration it merits so far as is compatible with improvement in function

It was pointed out on page 251 that few if any of the operations commonly described in texts for large partial or total reconstruction of the lip should be used. The best *functional and cosmetic result* can be obtained by limiting the plan to one of a few procedures It has been the author s experience that the procedure described on page 638 and illustrated in Figure 435 is the operation of choice when the condition of the bordering tissues permits its use *It is never necessary to cut into the musculature about the defect to effect repair* An entire lip either upper or lower can be lined and covered from the immediate vicinity of the defect with a minimum of scar or the tissue can be brought in from a distance The operation of Weber for the repair of a lower lip is sometimes useful and occasionally yields a good functional and cosmetic result It contemplates the use of flaps from beneath and from each side of the defect which are "laced," or alternately placed one above the other

Weber Operation for Large Partial or Total Loss of Lip

Case IV *Loss* All or a large part of the entire substance of the lower lip.

Requirements Covering supporting and lining tissue vermilion border

Procedure STAGE 1 The posterior surface of a flap (*A* in Fig. 434) will be exposed in the mouth and consequently will require an epithelial covering. This can be provided as follows

Undercut the entire attached surface of the proposed flap Make an impression with plastic dental modeling compound of the cavity thus created Cover the anterior surface of this model with split skin raw surface outward, and insert it into the cavity Apply a firm dressing and leave it in place for six to eight days. Remove the model at this time Dry the new cutaneous surface on the flap in the air and replace the model

Repeat this procedure for several days until organization of the new graft is completed

An interval of two weeks elapses.

STAGE 2. Outline and incise the flaps as planned (Fig. 434) Free the base of flap *A* Dissect flap *B* free from its underlying attachments and freely undercut its base Suture the upper distal edge of flap *A* to the angle of the mouth at point C Elevate flap *B* and suture it to the inferior border of flap *A* Close the defect in the neck produced by elevating flap *B* by undercutting the surrounding skin and sliding it, to suture to the inferior margin of flap *B* Paint the intra-oral suture lines with compound tincture of benzoin Dress the suture lines on the lip with gauze moistened with alcohol Remove the skin sutures in forty-eight hours and support with gauze collodion strips

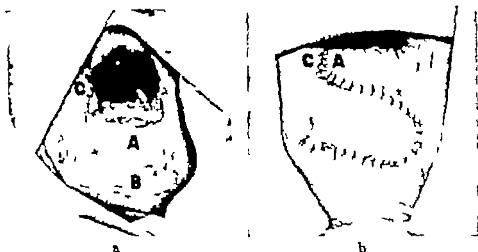


Fig. 434 Case IV Weber operation (cadaver demonstration) *a* Total loss of lower lip, outline of flaps on the chin and neck for the reconstruction *b* flaps transposed to repair the defect. Letters on face of illustration are explained in the text. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

An interval of two weeks elapses

STAGE 3 The mucous membrane for construction of a vermilion border for the lower lip is obtained from the upper lip or better by Owen s procedure of rotating a flap from the buccal mucosa which is based above and lateral to the angle of the mouth (see p 636)

Carry an incision through the mucosa from angle to angle of the upper lip along a line about opposite the mucocutaneous line on the anterior surface of the lip Make a short, vertical incision at each end of this horizontal one. Dissect the flap thus outlined free from the underlying muscle and suture its edge to the freshened superior border of the lining flap of the lower lip This suture line may be complete, across the entire border of the lip or a small part at one angle may be delayed to permit feeding the patient through a tube at this point. In either event, suture the lips together or apply a Barton bandage firmly and leave it in place for ten days.

An interval of ten to fifteen days is allowed to elapse between Stages 3 and 4

STAGE 4 Dissect the mucous membrane flap attached to the upper lips upwards for a distance of ⅜ inch (about 1 cm.) and free it by a horizontal incision parallel with the original one Suture the free edge of the mucous membrane flap thus obtained to the freshened superior border of the covering skin of the lower lip Freely undercut the mucosa bordering the defect in the lining of the upper lip and close the defect with interrupted horsehair sutures.

Reconstruction with Skin Flaps for Large Partial and Total Loss of Lip

Case V This reconstruction is completed in four stages, with proper intervening intervals of time (Smith s method)

The principles of this procedure have produced desirable results over a period of years The method of obtaining a mucous membrane lining is much improved by the contribution of Owen, which permits completion of the technical effort in a single procedure.

The author has never felt sure of obtaining an adequate flap of buccal mucosa based desirably with good blood supply and subsequently closing the defect. This is, however readily accomplished.

The desire to use this membrane without resort to a previous skin flap and its subsequent multiple excision led to tubing a flap as seen in Case IX (Fig 439 *d* p 645)

The procedure described here is essential in such cases where long continued radiation has damaged the blood supply of the membrane and where trauma has broken its continuity The use of the Owen flap permits the rotation of the covering flap nearer to the mouth with a resultant better located scar

Owens' Operation Make an accurate rectangular, tinfoil pattern of the defect.

Bisect the pattern and rotate each half laterally using the superior lateral corner as the pivot, to outline a flap on the adjacent chin and cheek

Incise the lateral border down its lower half thus leaving the upper half to the angle of the mouth and adjacent cheek as its pedicle The mesial border is incised its full length.

The flap is elevated from the mucosa carrying with it sectional portions of the triangularis and quadratus inferior muscles, whose motor nerve supply comes from the mandibular branch of the seventh nerve The triangularis inserts in and interlaces with the orbicularis oris and risorius muscles at the angle The degenerated fibrous remnants of these sectioned muscles serve to support the new lip at the insertion and transmit some traction from these muscles

The lining from the buccal mucosa is obtained in an exact manner The pattern is fixed again with a point at the angle of the mouth the lower border running along the sulcus and the upper one beneath the

outlet of Stensen's duct. The flap is cut slightly wider than the pattern to provide a new vermilion border for the lip

It is dissected up to its base, the cheek defect closed by approximating with 0000 silk sutures, the lower border of the rotated flap sutured to the mucosa along the bottom of the lip defect in the same manner and the superior border sutured to the edge of the skin covering flap The lower edge of the covering flap is approximated to the skin of the lip defect with 00000 Dermalon. The defect resulting from the flap is closed by elevating and sliding the bordering cheek skin

This excellent lining flap is applicable to any type of skin covering flap The ease of obtaining and applying it in a single procedure makes it superior to any other method.

Smith's Method: *Procedure* STAGE 1 DEBRIDEMENT AND PREPARATION (IMMEDIATE) The management of the borders of the defect must anticipate reconstruction of the lip Flaps for a lining to replace the lost mucosa, for the outer skin covering and for the vermilion margin must be so planned that ample material enjoying an adequate *blood supply* is available

The blood supply of the *lining flap* which will be reflected from the skin adjacent to the angle of the mouth must come from the buccal mucosa and the muscle bordering the defect. Consequently the mucosa on this edge must be undermined and accurately approximated to the skin with fine closely placed horsehair sutures This produces a minimum of scar and a maximal blood supply This blood supply is usually adequate, but it can be guaranteed by outlining, partially undercutting, and again approximating this skin flap at this stage (Fig 435 *c A*)

The *covering flap* (Fig. 435 *c B*) is outlined next. It can be raised and sutured in its original location at this time if the blood supply is questionable. The blood supply however is usually excellent.

It is sometimes advisable to utilize flaps from both sides of the mouth in the construction of an entire lip When this method is followed, a long covering flap and a shorter lining flap should be cut on one side and the reverse procedure practiced on the opposite side This will place the junction line of the covering flaps at a different place from that of the union of the lining flaps and will prevent a depressed, adherent scar line (Fig. 437 *e*)

The mucosa bordering the edge of the remnant of the lip is similarly undercut and sutured This mucosa will be utilized to form the *vermilion border* of the reconstructed portion of the lip (Fig 435 *c d C*)

The remaining skin bordering the defect—chin or face and nose—is undercut and accurately approximated to the mucosal remnant along the buccal sulcus. The suture lines are painted with compound tincture of benzoin until they have become thoroughly sealed. A strip of gauze is fastened with collodion to the cheeks on each side to limit movement. The wound in the cheek (incised flaps) is covered with an alcohol dressing fixed with adhesive tape

An interval of three weeks elapses

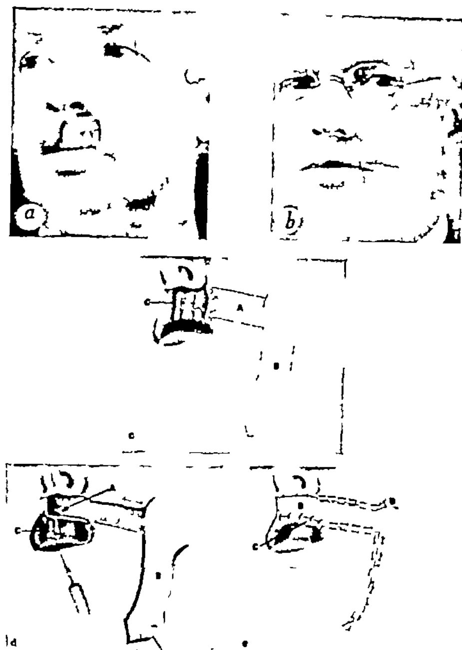


Fig. 435 Case V subtotal loss of the upper lip a, Patie-
b End result. c, Method of managing the skin and mucous
of the defect outline of the lining flap, A and covering
d Lining flap in situ, A; covering flap, B and m
sected. e Skin covering flap rotated and a
border flap sutured in position, C skin def
D is explained in the text, under Stage 4
the mouth when the buccal mucosa is

STAGE 2 PREPARATION OF LINING The purpose of this is to destroy hair follicles

Incise the superior and inferior borders of flap *A* (Fig. 435 *c*) Elevate the skin and place a spatula under it. Shave the epithelium deep into the corium Obtain hemostasis by sponge pressure Cover the surface with a thick split skin graft from the arm or leg Fix with a basting stitch. Apply a layer of gauze permeated with scarlet red ointment, several layers of gauze and firm pressure with adhesive strips leave in place for six to eight days Dress at intervals, subsequently until the graft has become organized

An interval of two weeks elapses.

STAGE 3 RECONSTRUCTION The mucous membrane on the edge of the remnant of lip is elevated between two parallel incisions placed 1 cm apart One incision is carried down its line of union with the skin and the other through the mucosa on the posterior surface of the lip The blood supply of the remnant is provided by the mucosa on the free margin of the lip and a broad portion of mucosa posteriorly Flap *C* formed by the maneuvers just described, is held on a sharp hook It will form the vermilion border of the reconstructed lip (Fig. 435 *C*)

The *skin flap* (*A* in Fig. 435) carrying underlying fat, is turned from the face on a "hinge" and sutured to the incised margin of the mucosa on the posterior surface of the remnant of lip and along the superior border of the defect.

The *covering flap B* is incised and elevated with the underlying fat (Fig. 435) The skin of the face on each side of the defect, resulting from the elevation of the covering flap *B* is freely undercut and approximated with horsehair sutures Approximation of these skin edges adds two thirds of the width of the flap to its length This covering flap *B* (Fig. 435 *d e*) is rotated 90 degrees to cover the lip and the defect left by reflection of the lining flap *A* (Fig. 435) The opposing skin edges are sutured with horsehair

The anterior edge of the *mucosal flap C* (Fig. 435 *d e*) is sutured to the free edge of the covering flap with horsehair Its posterior edge is sutured to the lining flap

The suture lines about the mouth are painted with compound tincture of benzoin, and those on the face and neck are covered with a gauze dressing wet with alcohol All stitches in skin are replaced on the second or third day with gauze collodion supports which are maintained a minimum of ten days

An interval of thirty to sixty days elapses.

STAGE 4 CORRECTIONS The teat, *D* (Fig. 398) created by rotation of the covering flap *B* (Fig. 398 *d e*) is adjusted by removal of excess skin and suture This should not be done sooner than the twelfth day because of possible damage to the blood supply of the transplanted flap prior to this time Any other cosmetic defects are corrected at this period.

The skin lining of the lip which is formed by reflection of skin from the face may be replaced by mucosa, if there is reason to do so, at any

time after sixty days. This is effected by multiple excision Approximately half the skin can be removed at the first stage and buccal mucosa ad vanced to fill the defect Sufficient relaxation of the mucous membrane will again occur at the end of four to six weeks to permit further excision.

Case VI. Ulcerating Mixed Basal and Squamous Cell Carcinoma of the Lip, Nose and Cheek. This was a lesion of long standing which had been partially controlled by six years of x-radiation, *surgery and local applications. It had perforated* the lip, invaded the left ala, the floors of both nostrils, the columella and the adjacent cheek. The continued radiation had apparently obliterated the bordering lymphatics. There were no discoverable metastases.

The desirable plan of repair included reconstruction of half of the left ala, the entire columella, the recovering of both nostril floors and the lip with normal bordering skin, as well as mucous membrane lining for the lip. The patient s age, seventy four and relaxed skin permitted the use of a wide flap and closure of its bed.

Procedure STAGE 1 The entire lip was incised from the mucocutaneous junc tion on the right side vertically upward to the lateral nostril floor A skin incision was continued to and around the junction of the skin and nasal lining to the membranous septum. This septum was incised up to the level of the columellar-tip junc tion and the incision carried through the columella at a right angle and continued from the bottom of the septal incision on the left side around the junction of the floor skin and nasal lining to and through the left ala to amputate its posterior half The incision was carried widely around the alar-cheek ulcer and down to a point ⅜ inch (1 cm.) above the angle of the mouth, and continued along the mucocutaneous line to the point of beginning in such a manner as to preserve the labial (coronary) artery (Fig. 436, *a*, p 641)

A skin flap was planned and outlined on the left cheek and neck of sufficient width and length to cover the lip permit loose folding to repair the left ala, cover *the floor of the left nostril fold again to replace the columella and terminate as the* covering of the floor of the right nostril. The base of this outlined flap terminated above the angle of the mandible (Fig. 436, *a*)

The flap was elevated above the fascia, and the skin of the neck was freely ele vated below the incision.

The flap was rotated 90 degrees, and traction made upward and inward on the neck skin, approximating it to the cheek skin edge with deep 00 plain catgut suture The skin surface was sutured with 00000 Dermalon (Fig. 436 *b*)

The mucosa was separated from the muscle along the incised cheek border and elevated posteriorly and inferiorly below the opening of Stensen s duct. The mucosa of the right lip was elevated. The left buccal mucosa was drawn upward and inward to approximate the mucosa from the lip and sutured with 0000 silk. The suture was continued along the mucous border of the lower lip remnant.

The infra-orbital skin *bordering the defect was elevated up to the orbital margin.* The superior edge of the skin flap (Fig. 436 *b* p 641) was folded loosely to suture to the skin edges of the ala both laterally and mesially Suture on this edge was con*tinued to the nasal lining on the nasal floor*

The distal end of the flap was reflected out of the nose and folded loosely and the edges sutured to the incised membranous septum to replace the columella. The *remaining* distal end of the flap was sutured in the right nostril floor and on down the incised right lip and along the vermilion line of the remaining left lip (these sutures should pass through mucous membrane only in order to protect the artery) (Fig. 436 *b*)

The intrabuccal approximation line was sealed with compound tincture of benzoin, and the nostrils were loosely packed with narrow iodoform ribbon gauze. The skin surface was covered with a few layers of gauze wet with alcohol. Fluffed gauze was added and a bandage applied with moderate pressure

The surface stitches were removed on the third day and supported with strips of 30 mesh gauze applied with collodion (U.S.P.)

An interval of 2 weeks elapsed.

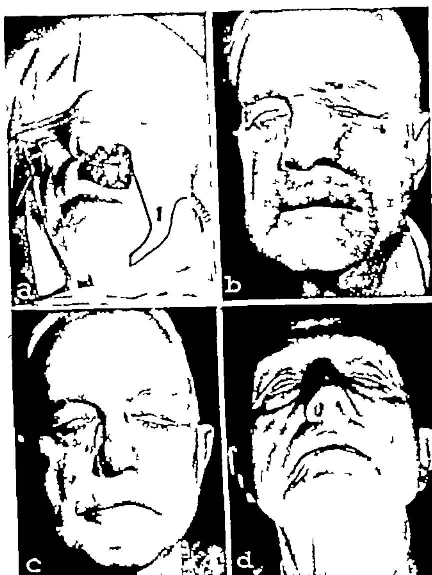


Fig. 436 Case VI ulcerating, mixed basal cell and squamous cell carcinoma of lip, nose and cheek six years of treatment with radiation, surgery and topical applications. *a*, Excision of lip, nose and face lesion outline of flap on the left cheek and neck of sufficient size to fold for the reconstructed ala, cover of the nasal floor fold for the columella, and cover the right nostril floor as well as the surface of the lip *b* Elevation and rotation of the flap, closure of the cheek and neck defects, and application of flap skin to the lip. *c* and *d* Result of the procedure. (See text on p 640 for a detailed discussion and the procedure.)

STAGE 2. ADJUSTMENT OF SKIN FULLNESS CAUSED BY ROTATION OF THE FLAP The scar was incised along this fold, the lateral bordering skin was elevated, and the overlapping excess was excised and resutured.

An interval of ten days elapsed.

STAGE 3 REPOSITION OF THE LEFT ALA. The width and length of the reconstructed alar fold on the left cheek were measured and outlined to determine the required length to fold it mesially and plant it at the base of the columella. The fold was

incised along this line. The incision was carried into the skin on the nasal floor for the desired distance mesially The border skin on this incision was elevated slightly the ala was rotated, and its two skin surfaces were sutured in position.

The result of these procedures is presented in Figure 436 c d. The pictures were taken five years after the surgery

Case VII. Squamous Cell Carcinoma, Submental and Submaxillary Glands. This is another example of a lip made with flaps from the adjacent tissue It differs, however in that the lining was made from two lateral flaps of unequal length and the skin covering of flaps of opposite lengths to permit different lines of suture and prevent a subsequent retracted scar

The involved lip was excised, mucous membrane sutured to skin edges and the submental and digastric triangles were dissected in the first stage (Fig. 437 *a* p 643) After an interval of three weeks the lip was constructed.

The lip with some muscular action in the effort to whistle is presented in Figure 437 *b* and at rest in Figure 437 *c*

Case VIII Squamous Cell Carcinoma. The patient, aged fifty-six, had a fissure in the center of the lower lip two years previous to this examination. This was treated locally with escharotic pastes and later excised but it shortly recurred. It extended laterally in the lip margin and into the lip substance. There were no palpable glands.

The lip was excised, and covering flaps of the type pictured in Figure 437 *d f* (p. 643) were rotated and sutured. The mucous membrane lining was obtained by sliding flaps of buccal mucosa. The patient is presented twenty years later after excision of a large patch of hyperkeratosis on the right cheek.

Case IX. Squamous Cell Carcinoma, Grade II; Lip and Cheek. The patient's condition at the time of examination is presented in Figure 439 *a* (p. 645) He had a fungating, ulcerating, rapidly growing tumor of the right lip which extended into the adjacent cheek 1 inch (2.5 cm.) There were palpable glands in the submental area and the cervical chain.

A small mass had first been noticed at the right angle of the lip four months previously This was treated by x-radiation. It began as a rapid growth and ulceration three weeks previous to this time.

Procedure STAGE 1 An incision was made from the left submental area along the line of the right digastric muscle to the sternomastoid muscle, thence down its anterior border to the clavicle, and posteriorly above the clavicle to the border of the trapezius muscle. The anterior and posterior skin flaps were reflected, and a block excision of the sternomastoid muscle, carotid sheath, jugular vein and gland bearing tissue from the midline to the trapezius border and upward to the border of the mandible was accomplished.

The lip was excised from the middle of its left half and buccal sulcus to and including the involved adjacent cheek area.

The cheek skin was freely elevated from the fascia, advanced mesially under traction, and sutured to the bordering mucosa. The mucosa around the borders of the lip excision was sutured to the bordering skin edges (Fig. 439 *b c*)

An interval of three weeks elapsed.

STAGE 2. PREPARATION OF COVERING FLAPS. A rectangular flap of the type presented in Figure 439 *d* was outlined on both cheeks and submaxillary neck areas. The long borders of the right flap were incised, and the skin of the distal half was elevated and grafted with split skin for ultimate lip lining. The left flap was elevated and delayed.

An interval of two weeks elapsed.

STAGE 3 LIP RECONSTRUCTION Both flaps were elevated. The bordering cheek skin was elevated, approximated to the mesial borders of the defects, and sutured with

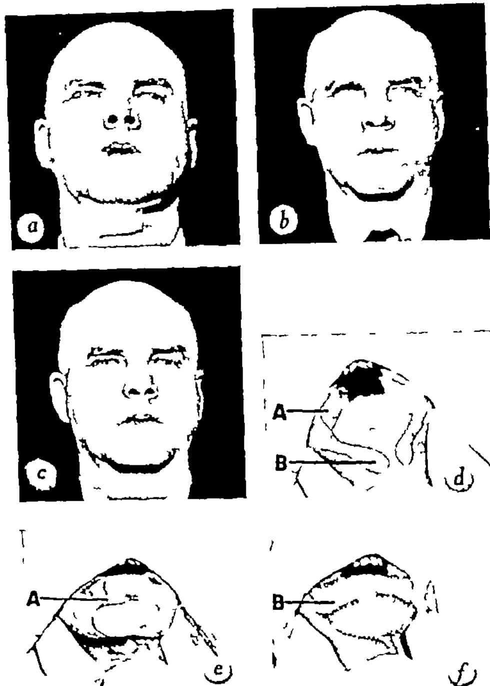


Fig. 437 Case VII reconstruction of the lower lip *a* Appearance two weeks after excision of lip and dissection of both digastric and submental triangles *b* muscular action of the reconstructed mouth, *c* the reconstructed lip *d*, outline of flaps *e* lining flaps, *A* transposed *f* covering flaps, *B* transposed defect in skin of neck closed. *d e* and *f* are cadaver demonstrations.

00000 Dermalon. The mucosa on the left lip remnant was incised down its skin attachment, and a second incision was made on the buccal side from a point ¼ inch

(0.5 cm.) below the free lip margin to the sulcus mucosa joining the skin of the chin. The flap included between these incisions was elevated for construction of a vermilion border (see Fig. 435 c p. 638) The union of buccal mucosa and chin skin was incised.

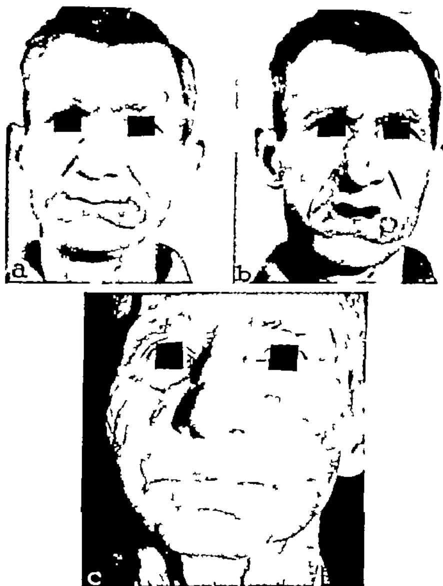


Fig. 438 Case VIII squamous cell carcinoma. *a* and *b* The rotated flap reconstruction of the lip *c* the patient s condition twenty years after surgery (See p. 643 for detailed discussion)

The mucosa was separated from the left lip remnant and bordering cheek. This was drawn mesially and sutured to the remnant of sulcus mucosa. The skin f were rotated 90 degrees and their distal end sutured on the left of the mid provided grafted lip lining up to the edge of the mucosa drawn mesially fr remnant. These two edges were sutured with 0000 silk and the low approximating the chin skin with 0000 Dermalon. The mucosal flap r

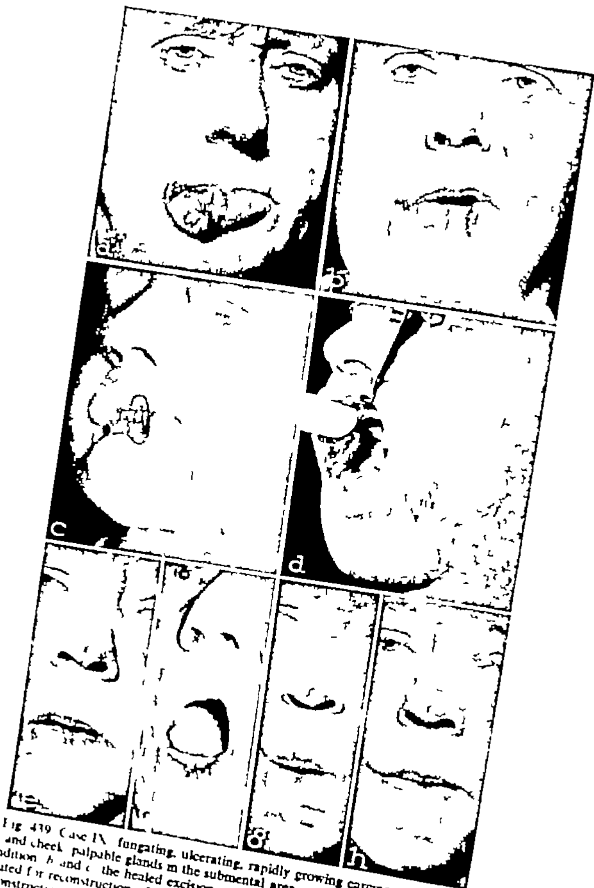


Fig. 439. Case IX. fungating, ulcerating, rapidly growing carcinoma of the right lip and cheek, palpable glands in the submental area, cervical chain. *a* The original condition. *b* and *c* the healed excision and the outline of a cheek, neck flap to be rotated for reconstruction of the lip. *d* tubed pedicle and flap of buccal mucosa for reconstruction of the vermilion border. *e*, *f*, *g* and *h* the result of this procedure and the ability of the patient to exercise mouth and lip function. (See text on p. 64 for detailed discussion.)

(0.5 cm.) below the free lip margin to the sulcus mucosa joining the skin of the chin. The flap included between these incisions was elevated for construction of a vermilion border (see Fig. 435 c p. 638) The union of buccal mucosa and chin skin was incised.



Fig. 438 Case VIII squamous cell carcinoma. *a* and *b* The rotated flap reconstruction of the lip *c* the patient s condition twenty years after surgery (See p 643 for detailed discussion.)

The mucosa was separated from the left lip remnant and bordering cheek. This was drawn mesially and sutured to the remnant of sulcus mucosa. The skin flaps were rotated 90 degrees and their distal end sutured on the left of the midline. This provided grafted lip lining up to the edge of the mucosa drawn mesially from the lip remnant. These two edges were sutured with 0000 silk and the lower flap edges approximating the chin skin with 0000 Dermalon. The mucosal flap raised from the

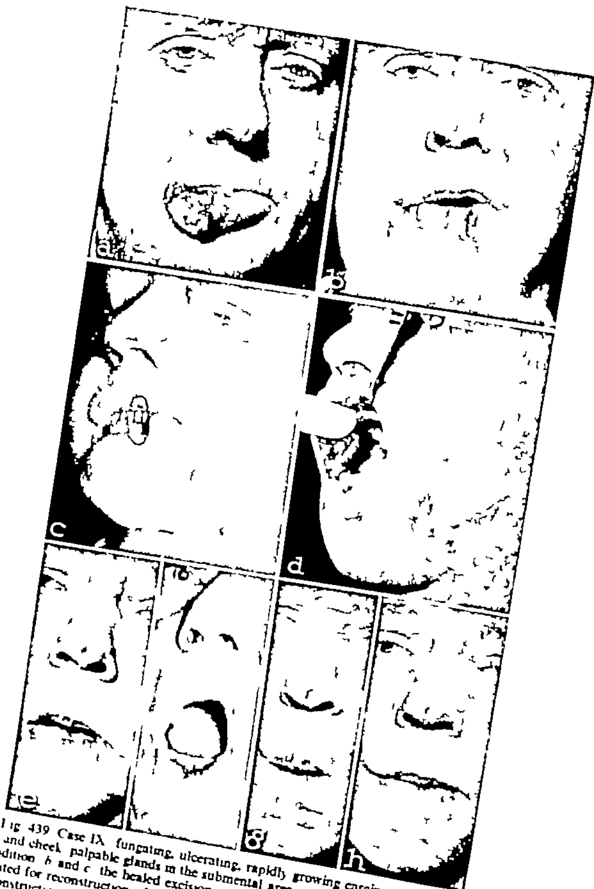


Fig. 439 Case IX fungating, ulcerating, rapidly growing carcinoma of the right lip and cheek palpable glands in the submental area, cervical chain. *a* The original condition *b* and *c* the healed excision and the outline of a cheek, neck flap to be rotated for reconstruction of the lip *d* tubed pedicle and flap of buccal mucosa for reconstruction of the vermilion border *e* *f* *g* and *h* the result of this procedure and the ability of the patient to exercise mouth and lip function. (See text on p. 64 for detailed discussion.)

left lip remnant was sutured along part of the superior flap edge as vermilion border (Fig. 439 *d* p. 645)

STAGE 4 Two months later a tube of supraclavicular neck skin was constructed, moved up to the submaxillary neck area, and used to replace the skin lip lining. This tube thrombosed, and the new lining was lost.

An interval of three months elapsed.

STAGE 5 TUBING BUCCAL MUCOSAL FLAP A flap of sufficient width for lining and a vermilion border with its base above the angle of the upper lip was tubed (Fig. 439 *d*)

An interval of three weeks elapsed.

STAGE 6 INCISION AND DELAY OF FLAP ON THE TUBE. A flap ½ inch (13 mm.) long on the posterior end of the tube was elevated and delayed.

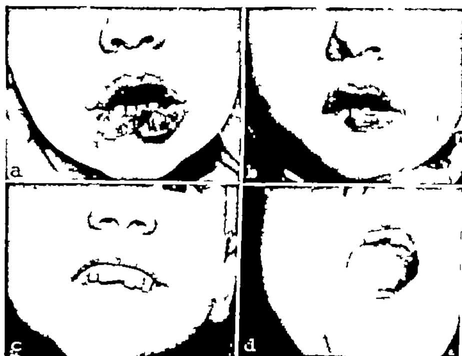


Fig. 440 Electrical burn of the lower lip *a*, The original lesion *b* the lip after excision of the scar and suture of the mucosa to the skin *c* and *d* the result of the procedure. The scar pull in the right lower lip should be corrected by a Z plastic. (See text for detailed discussion.)

An interval of three weeks elapsed.

STAGE 7 ROTATION AND APPLICATION OF TUBED FLAP The flap was elevated, and the tube was opened along its approximation line, rotated, and applied to replace the scar lip lining and the remaining vermilion defect.

The result of these procedures is presented in Figure 439 *e f* These pictures were taken six years after the lip excision.

Burn Loss—Electrical. This fourth degree burn with loss of entire lip substance down to the sulcus is not an infrequent trauma, in some degree in children It results from biting an electric cord wire

The immediate loss is seen in *A* and the healed condition in *B* of Figure 440 The reconstruction was then accomplished eight weeks after complete healing.

Procedure Make a V incision in normal skin on the sides of the scar tissue

Incise the mucocutaneous line of the lip Elevate the vermilion freely Free the buccal mucosa from the muscle Avoid the labial artery Elevate the vermilion remnant at the angle of the mouth. Incise the buccal mucosa posterior to the angle and slightly above the sulcus for ¾ inch (2 cm), and elevate this flap

Dissect the scar completely except a narrow strip along the sulcus for approximation with the new lining.

Approximate the lip mucosa and this buccal flap Suture to the sulcus scar with 0000 silk

Incise the mucocutaneous line of the right upper lip for ⅜ inch (1 cm)

Elevate the skin of the cheek bordering the V incision and the angle of the mouth Slide this skin medially to approximate the other incised edge and suture with 00000 Dermalon.

Approximate and suture the vermilion to the mucosal tab at the angle.

Determine accurately the normal position of the angle attachment in the overlapping skin which has been drawn mesially to cover the lip defect. Mark this with a needle and dye. Split the overlapping skin horizontally to this point. Remove the excess tabs of skin overlying the mucocutaneous incised line Suture this approximation on both lips with 00000 Dermalon Suture the posterior edge of the vermilion to the new lining with 0000 silk.

Seal the mouth suture lines with compound tincture of benzoin

The result of this procedure several months after completion is presented in Figure 440, *c d* The scar pull in maximum open bite depresses the angle of the mouth This is not evident in ordinary opening of the mouth and, consequently does not merit correction which would principally add cosmetic disability

Extensive Losses in Which Flaps from Adjacent Regions Cannot Be Used

Extensive losses of the lips cheek and other surrounding structures cannot be repaired from the neighboring tissues. The attempt to effect such repair would involve further destruction of function and produce greater cosmetic disability

Source of Material. The required tissues must be obtained from that part of the body offering the best material and the most certain and comfortable conveyance with the least cosmetic disability The *covering* and *lining* tissues are best supplied from the neck and arm when available (p 16 and Figs 4 6 7 see also Fig. 442) The tissue may be obtained from the back, chest or abdomen if necessary

Planning This must include consideration of the patient s comfort during the repair and the time involved, as well as the prime considerations The pedicle and flap which it conveys must be so planned that it will meet all the requirements except that of supporting tissue. Flaps

from the *forehead* and *scalp* should be avoided unless they meet a particular requirement.

In cases of extensive loss of bone, prosthetic supports or scaffolding must be applied during the period of reconstruction of the soft tissues and later replaced by bone and cartilage, or both together with such other supporting tissues as are necessary to obtain contour and so forth

The defect pictured in Figure 441 results from loss of the full thickness of part of the lips and adjacent cheek. Loss of this extent constitutes a borderline case in the planning and choice of material. It may be repaired from the neighboring tissues without objectionable added cosmetic disability or it may be repaired with tissues obtained and transported from a distance All the necessary tissue to replace the skin covering, the *lost mucosal lining, and the supporting or filling tissue* can be furnished by a pedicle flap from the arm. The required mucosa for the vermilion border of the repaired defect is obtained from the upper lip or the buccal mucosa

Procedure. *Stage 1* Outline a flap of the desired width and length on the lateral surface of the arm so that its base or pedicle is located on the shoulder Incise the lateral borders of flap *A* to leave a lateral bridge of skin at points *B* and *C* (Fig 441) and completely outline the distal portion *E* Elevate the distal portion of flap *E* and undercut the skin of the entire flap to point *D*

Pass sutures armed with a needle on each end through the inferior margin of flap *E* and through the under surface of the flap at point *B* Draw flap *E* under the main flap with the sutures and tie lightly Suture the edge of the infolded flap to the edge of the covering flap along the incised line between *B* and *C* Close all incisions with interrupted horsehair sutures.

Stage 2 A minimal interval of three weeks is allowed to elapse between Stages 1 and 2.

Again incise lines *A* Undercut the skin and attached fat of the outlined flap Control carefully all bleeding. Suture the raw edges of the *flap to form a tube Undercut freely the surrounding skin on the arm* Pass one or two strong relaxation sutures (Fig. 134) and approximate its edges with interrupted sutures of horsehair Dress with fluff gauze so arranged as *not to constrict the newly formed* tubed pedicle, and apply a moderately firm bandage.

Stage 3 An interval of three weeks is allowed to elapse between *Stages 2 and 3*

Incise the bridges of skin at *B* and *C* (Fig 441) The flap may be utilized if the blood supply in the distal doubled flap *F* remains adequate on elevation and rotation of the pedicle. *Otherwise it is sutured again* and allowed to remain on the arm for a subsequent period of ten days or two weeks. It is again elevated and rotated at this time, to determine the adequacy of its *blood supply This process of "delay" is repeated* until the blood supply is satisfactory

The lining is split from the skin covering around the margins of the

defect. The folded skin at the distal end of the flap is incised, and the incision is carried around its inferior border to separate the lining and the

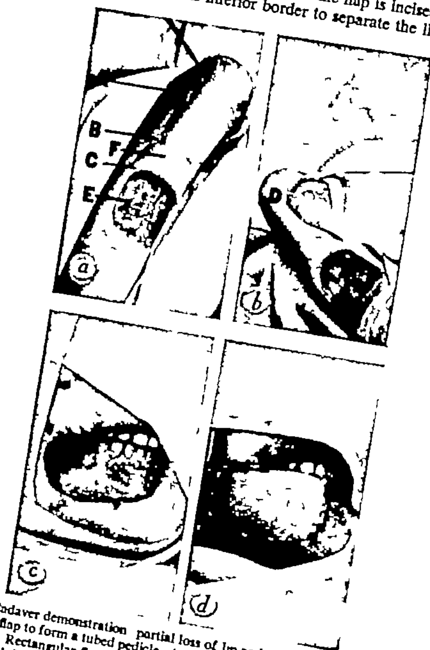


Fig. 441 Cadaver demonstration partial loss of lip and adjacent cheek. *a* Border incisions of a flap to form a tubed pedicle *A* flap folded to provide double epithelial surfaces, *F* *b* Rectangular flap sutured to form a tubed pedicle, *D* closure of the resultant skin defect. *c* Defect in the cheek and lip. *d* Tubed pedicle flap sutured in the defect pedicle amputated. Letters on the face of the illustration to which reference is not made in the legend are accounted for in the text.

covering. The superior border of the rotated flap forms the free margin of the reconstructed lip That part of this margin which approximates the cheek is incised to separate the lining and covering layers.

The head is rotated toward the shoulder the shoulder elevated, and the flap swung into the defect (Fig. 203) The lining and skin of the

flap are approximated to the borders of the defect with interrupted sutures The arm and head are fixed with a plaster dressing to prevent damaging excursion (Figs. 6 8 see also Fig 17)

The interval between Stages 3 and 4 is three weeks

Stage 4 Excise the tube at the posterior border of the defect and adjust its base to the surrounding skin of the shoulder Adjust the posterior part of the flap and suture it to the tissues of the cheek.

Extensive Loss of Lip and Surrounding Structures

This case (Fig. 442) is introduced to indicate a procedure for the repair of extensive loss of the structures to be named.

Loss. Total upper lip except the vermilion border adjacent cheek eyelids, eyeball, part of naso-orbital wall nasal lining, and nose

Requirements. Epithelial lining for the nasal cavity fat and skin for filling and covering of the orbit, skin covering for the face lining, covering and supporting substances for the lip lining covering, and supporting tissues for the nose All these requirements, except the supporting tissues for the nose are supplied by a properly planned tubed pedicle flap from the arm

The entire reconstruction is planned, not only as to introduction of tissue, but also as to stages of the procedure.

Procedure. *Stage 1* A period of three to four weeks is required for preparation of the tubed pedicle flap on the arm (p 16)

The shoulder is elevated and the forearm flexed 90 degrees the head is rotated toward the shoulder and a plaster dressing applied to the head and arm to fix it. The plaster bandage about the head is fixed over a skull cap which permits limited motion (Fig. 6 see also Fig. 17)

Dissect the fat from the skin of the distal end of the flap and suture it in the nose to replace the lining and furnish the future abutment for the reconstructed nose The remaining fat, attached to the distal flap furnishes a filling for the orbit. Suture the margins of this flap into the orbital and bordering defects in the cheek

It is well to support the tubed pedicle during the first days of this period with a sling attached to the plaster head cap The disturbed circulation following rotation results in marked edema and increased weight for a few days. Care must be given that this supporting sling does not constrict the circulation

Stage 2 The interval between Stages 1 and 2 is three to four weeks.

Estimate the length of the tube required for repair of the defect in the cheek and lip and incise partially its sides at this point (Fig. 459) The incisions are extended after the lapse of three to four days if no sizable vessel is encountered and the circulation is not visibly disturbed This process is continued until the pedicle has been entirely severed.

Excise the scar line in the pedicle Dissect the skin of that distal part which is to become the lip sufficiently to permit its suture to the two surfaces of the remaining free border of the lip

Approximate one skin edge of the pedicle to the skin of the facial

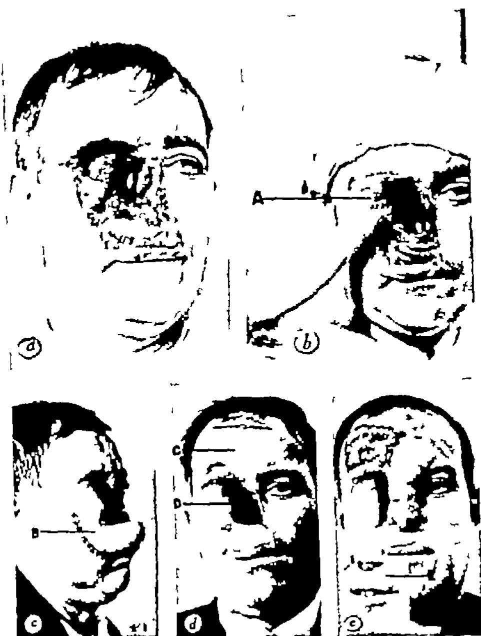


Fig. 442. Construction of a lip from a tubed pedicle flap *a* Loss of nose, lip, cheek eyelids and orbital content, and partial loss of mesial wall of the orbit. *b* Tubed pedicle arm flap carrying fat for obliteration of orbit flap has been folded into the nose to furnish a lining for its lateral half the margins of the flap are sutured to the defect about the orbit, *A* *c* Pedicle has been amputated scar line of the tube has been opened and sutured to the bordering skin of the cheek and the residual vermilion margin of the lip. *d* Foundation abutment for nose completed lip partially constructed construction of a new nose on the forehead begun, *C* *e* The new nose without cartilage support, sutured in position. Further reduction of fat in the constructed lip. *Inset* Completed construction of lip *E*. Letters that appear on the face of the illustration but not in the legend are explained in the text. (Ferris Smith Reconstructive Surgery of the Head and Neck. Thomas Nelson and Sons.)

defect, beginning at the superior portion of the pedicle, with interrupted horizontal mattress sutures of horsehair The skin on the mesial side of this part of the pedicle is ultimately removed to permit adhesion to the defect in the cheek. It must be retained until circulation of the lip has become adequately established (Fig. 442 *B*)

Split the superior margin of the remaining lip border and suture its posterior edge to the skin of the posterior aspect of the pedicled flap Suture the skin margin of the anterior aspect of the pedicled flap to the edge of the external surface of the remaining lip border Adjust and suture its distal end to the edges of the lining and covering of the cheek.

Incise and undermine the forehead flap for the nasal reconstruction along part of its superior border (Fig 442 *C*) Introduce a full thickness, or a thick intermediate skin graft beneath the scalp and suture its edges to the flap incision to form the lining of the new nose

Apply a gauze dressing and a firm bandage and allow it to remain for seven to twelve days, depending on the type of graft used (p 19)

Stage 3 An interval of three weeks is allowed to elapse between Stages 2 and 3

Dissect the skin from that part of the pedicle which approximates the cheek in the infra-orbital region and near the canine fossa Retain all the included fat Suture the incised skin edge to the nasal lining. This edge (Fig. 442 *d*[*D*] *e*) will form the abutment for the reconstructed nose

Open the scar line along the anterior surface of the lip reduce the fat content of the flap and again approximate the skin Repeat this process at intervals until the lip presents the desired form and thickness (Fig. 442 *E*) Incise the entire border of the forehead flap for the nose (Fig. 442, *e*) and elevate except at its pedicle attachment and at the point of entrance of the temporal artery into its distal end Resuture in position.

The interval between Stages 3 and 4 is three weeks

Stage 4 Incise and elevate the nose flap Form the tip and nostrils as described on page 547 (Fig. 370) and rotate the flap on its pedicle This pedicle now includes the left anterior temporal supra-orbital and frontalis arteries Split the lining skin from the covering along the inferior border of the flap and suture it to the skin and nasal lining of the left cheek and to the split edges of the superior margin of the new lip construction Cover the scalp defect with a thick split skin graft

An interval of three weeks is allowed to elapse between Stages 4 and 5

Stage 5 Split vertically the transplanted skin forming the right nasal lining and the covering of the right cheek and orbit and suture to the incised right edge of the reconstructed nose Suture the lining skin with catgut and the covering skin with interrupted stitches of horsehair

An interval of two weeks elapses between Stages 5 and 6

Stage 6 Incise the nasal flap in the glabellar region readjust its pedicle

on the forehead and adjust the glabellar stump of the nose to its inferior margin The cartilage or bone support may be introduced into the nose (Figs. 373 e 385, 386) as soon as thorough organization of these su ture lines has occurred.

A prosthetic eye can be provided by the procedure described on page 443 see also Figures 122 and 287

CAVERNOUS HEMANG OMA

Various types and degrees of involvement of capillary and cavernous hemangioma or both are frequently presented in the lip as elsewhere The problem of desirable correction is the same as elsewhere and, in general, is surgical except in small lesions in which the blood spaces may be sclerosed and obliterated without consequent cosmetic disability



Fig. 443 Hemangioma cavernous lesion with ulceration and frequent hemor rhage a and b The original condition c and d the result of ligation of efferent and afferent vessels and multiple excision

Case I. This patient, aged fifty-three presented a congenital cavernous lesion which had progressed through the years because of discouraging and frightening advice. She experienced several hemorrhages during this period. Recent and profuse hemorrhage necessitated examination and management. A recently controlled hemorrhage is evident in Figure 443 *a b* (p 653)

The correction was accomplished under local anesthesia in two stages.

Procedure STAGE 1 A strong quilting suture was placed through the substance of the lip from one angle to the sulcus, across the chin beneath the lesion to the opposite side, and up to the opposite angle.

An incision was made across the lip along the junction of the vermilion and buccal lining, avoiding the labial arteries. The vascular structure was clamped and excised. Bleeding was completely controlled by ligation.

The defect was approximated with 00000 Dermalon. The suture line was sealed with compound tincture of benzoin and dressed with moderate pressure.

An interval of three weeks elapsed.

STAGE 2. LIP RECONSTRUCTION The normal measurement between the angles of the mouth was determined. The lip was elevated and a median wedge excised (Fig. 416) the base of which on the vermilion equaled the excess lip length resulting from the presence of the mass.

The wound was approximated and sutured as pictured in Figure 416.

The result of this procedure is presented in Figure 443 *c d*



Fig. 444 Hypertrophied orbicularis oris muscle cavernous hemangioma of the lip and capillary hemangioma of the cheeks and neck. See also Figure 247 (p 369) (See p. 367 for a detailed discussion and procedure)

LIP PITS

This congenital anomaly is variously called a pit, sinus or fistula It is rated as one of the rarest anomalies in the human body It is a funnel shaped tract about 1 cm deep which terminates, ordinarily at the lip musculature

The pits are usually symmetrical bilateral and separated on the median line by a ridge of mucous membrane Some are elongated slits rather than round or oval depressions. They are said to be more common in the female and rarer in the upper than in the lower lip It is believed that hereditary developmental anomalies in this location are a factor Two of the four cases presented had no such history for three generations

The pits ordinarily contain mucus. They are said to lie near to the

division line between the smooth (pars glabra) and villous or red zones of the lip

Several variations from the descriptions are presented in the following cases

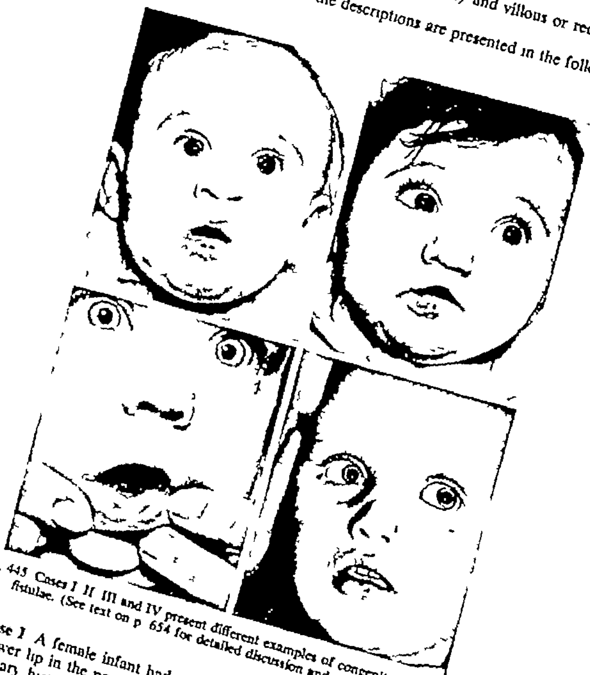


Fig. 445 Cases I II III and IV present different examples of congenital lip pits or fistulae. (See text on p 654 for detailed discussion and management.)

Case I A female infant had oval pits on the mucocutaneous line of the lower lip in the presence of a double cleft upper lip There was no hereditary history for two generations on both sides of the parents

Case II A female infant presented double pits of unequal size and shape on the lower lip in the presence of a single cleft of the upper lip The left pit is much the larger and occurred on the same side as the cleft. No hereditary history was obtainable

Case III A male infant presented oval pits on the line between the smooth and red portions of the lower lip He had no other deformities and no family history of this or other congenital anomalies.

Case IV A male infant presented double pits of equal shape and size He had a cleft of the hard palate and velum The mother had a cleft palate

The surgical management is simple. A horizontal, elliptical incision is made around both borders of the pits, and a wedge-shaped piece terminating at the muscle is excised, avoiding the labial arteries. A small probe will locate the bottom of the pit It may be aspirated, a drop of methylene blue instilled, and all stained tissue excised.

The defect is closed by suturing the posterior red portion of the mucosa to the inferior incised line This mucosa brought on to the free lip margin is frequently covered with a thin film of dried gland secretion which is annoying to the adult patient and suggests no remedy

CLEFT LIP

The effort to correct the cosmetic and functional disability of a cleft lip is practically as old as surgical history The several desirable cosmetic accomplishments associated with such clefts and the residual after the common effort of many years have inspired several technical improvements during the last three quarters of a century These improved the lip result, but generally ignored the finesse of the total procedure

The lip was closed by linear approximation with the certain resultant of scar contraction—a retracted notch in the free border It lacked the normal eversion of the free border· little was done to construct a normal nostril floor and place the ala in its proper relation to the columella the maldeveloped ala on the cleft side was not reconstructed along with the lip and, when so managed, the result was only occasionally desirable and, frequently added external scar· and the lower lateral cartilage was not placed in a position to correct the nasal tip

Mirault, at the beginning of the latter half of the last century de scribed a technic which in recent years, Blair and Brown modified and improved to receive wide acceptance Koenig recognized the cause of the lip notch and other distortions and proposed an offset suture line to prevent this linear contraction He ignored the fact that Denonvilliers had described the Z plastic years earlier for this very purpose

Hagedorn in the desire to correct some of the weakness of the Koenig procedure, proposed a quite different technic in 1884 which permits simple routine accomplishment of the several features of a good lip repair He failed, however to add any correction to the distorted nose which should accompany the lip procedure We have recently added some simple, obvious procedures which produce a good nostril floor nostril shape and a normal tip together with a good lip in a single procedure.

This procedure was discarded after a few years because of a lack of appreciation of its value and was replaced by newer proposals which are now common practice

Rose described a technic which, with modifications, has had wide acceptance Le Mesurier has recently awakened an interest in Hagedorn s procedure with demonstrations of his excellent lip results and technical appraisals

The following requirements must be accomplished in a desirable repair of a single cleft accurate approximation of the muscle, skin covering and mucous lining membrane an approximation line so designed that its contraction will not distort the immediate construction, a symmetrical mucocutaneous lip line slight eversion of the free lip margin symmetrical, normal nostril floors; vertical nostrils and a normal, balanced tip

Procedure. *X* is a selected point at the mucocutaneous junction permitting desired width of the reconstructed floor

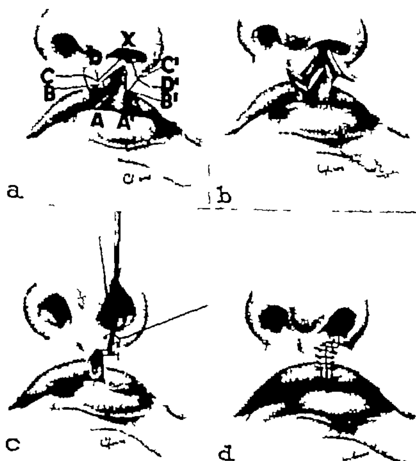


Fig. 446 Hagedorn lip procedure. See text for detailed discussion and the significance of the lettering in *a*.

Locate and mark with a needle and dye the most mesial point on the mucocutaneous line of the lateral cleft where the vermilion is of normal thickness (*B*) The length of a line at a right angle to the mucocutaneous junction from this point to the free vermilion border should be one third to one half of the total lip length *A* marks the end of this line on the free vermilion border

Mark a point *C'* at a distance from *B* equal to *A B* Draw a line from *X* to *C'*

Locate a point *D* marking the length of *B'C'* from the point *C'* and the mucocutaneous border Continue the drawn line from *C'* to *D*

These are the incision lines on this lip section The tissue mesial to these lines will be discarded

Locate a point *D* on the mucocutaneous line of the mesial lip segment at a distance from *X* equal to that of *XC'D'* Mark the line *XD*

Locate and mark a point *C* which has the same distance from *D* and the mucocutaneous line as *B'C'* and *C'D'*

Mark this distance as the point *B* on the mucocutaneous line The distance from *B* to the free vermilion border should equal *A B'*

The size of the triangle *BCD* depends upon the angle between the medial side of the cleft and a vertical line The greater the degree of angulation the smaller the triangle It is better made smaller than needed and enlarged as demanded.

The line *ACDX* marks the incision line The mesial tissue is discarded

Separate the lip from its maxillary attachment sufficiently to provide adequate relaxation

Incise the entire lip structure at a right angle to lines on the surface.

Incise the line *AB* Place a small sharp hook in the point *C* and make lateral traction on the lip This will permit accurate location of the line *BC* so that it meets the line *CD* at a right angle It will then properly approximate the flap edge *B'C'* and *CD* will meet *C'D'*



Fig. 446 (continued) *e* The diagrammatic procedure offered by Hagedorn in 1884

Elevate slightly the skin and mucous membrane edges to permit accurate suturing.

Free the alar attachment from the maxilla Split the connective tissue in an anterior posterior straight line from the alar margin on the incised edge to *X* Treat the incised edge on the mesial side similarly

Pass horizontal 0000 silk mattress sutures from *X* to the nostril margin to increase the approximating raw surfaces of the nostril floor

Pass a 00000 Dermalon suture through the alar edge and the base of the columella to position the ala accurately

Suture the muscle layer of flap *A B C'D'* to *ABCD* with one 00000 plain catgut suture in the line *ABC* one in the line *CD*, and a third in the line *XD*

Accurately approximate *AA* with 00000 Dermalon suture Continue with this suture in the skin and vermilion Suture the mucous membrane lining with 0000 silk.

Nose Asymmetry

Make an internal nostril incision 2 or 3 mm. from the free rolled border which begins at a point near the floor on the lateral alar wall and continues through the junction of the lateral and medial crura of the lower lateral cartilage and down the membranous septum to the floor This incises the connective tissue and cartilage to the base of the covering skin

Separate the covering skin by blunt dissection with a fine needle forceps or a small, round nose scissors

Locate the point where the curved junction of the lateral and medial crura should be normally Introduce a straight, blunt nose scissors, one blade between the covering skin and the cartilage and the other beneath the skin lining close to the nasal septum Cut from the point located for the cartilage junction to the pyriform margin.

Roll the mesial end of the incised cartilage up to suture to the opposite side

If the lateral cartilage-lining layer is excessive as it is likely to be as a result of its developmental distortion, and would produce fullness in the nostril, the excess is trimmed from the incised margin along the septum

Approximate the internal nostril incision with one or two fine Dermalon sutures

Fold a piece of ½ inch iodoform ribbon gauze to make a thin pad the height and shape of the normal nostril. Insert this in the nostril past the mucocutaneous floor line

Apply a collodion strip over the tip of the nose from one alar sulcus to the other Apply a second strip below the nasal tip from one to the other alar surface to make moderate pressure against the pad

Replace the skin stitches with gauze collodion strips on the third postoperative day remove the gauze nostril pads in four to six days and remove the stitches from the nose, vermilion border and mucous lining in eight to ten days. Retain the gauze collodion strip on the external nose throughout the dressing period

The objections to this type of lip repair are few and are far outweighed by its advantages

The angle made on the median side of the cleft cuts into the philtrum, but does not appear to influence the quality of the result

The tissue discarded is rather frightening to the surgeon during his first two or three experiences. This tissue however, is neither useful nor necessary for the repair

The staggered right angled lines of closure practically exclude deforming scar contractures and eliminate the stigma of the classical lip scar. Good lip eversion is invariably obtained.

Two cases demonstrating the result of this procedure are presented in Figures 447 and 448.

Case I This is a typical single cleft with hypertrophy of the skin scar lines (Fig. 447 *b*) which persists with little absorption at the end of eighteen months (Fig. 447 *c d*). This was typical of several early cases. *It was assumed that this is a reaction to too much and too heavy suture material.* The substitution of three or four sutures of 0000 or 00000 plain catgut has been adequate in all cases and has eliminated this complication.

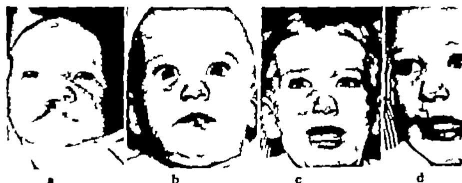


Fig. 447 Case I. This case is presented to demonstrate the discussion of suture material.



Fig. 448 Case II repaired in a similar manner with different suture material.

Case II This is the typical wide single cleft with a protruding premaxilla and the accompanying distortions of the tip nostril border ala,

and so forth The procedure described results in acceptable reconstruction of the nose and lip as well as rapid moulding of the premaxilla to its cleft alveolar process in a position for repair at the proper age

Case III Double Cleft with No Protrusion of the Premaxilla. It is difficult for the author to discuss the technical procedure of the primary repair of double cleft lip with the desire to indicate a standard procedure that assures routinely a standard result. This does not seem possible. The several technics generally followed today are the conceptions of able surgeons who have altered to a slight degree the incisions and closures of seventy years ago In some instances this is done without note that the recommended procedure is a slight modification of an older one for the purpose of improving in some particular feature the usual standard result accomplished by good planners and technicians

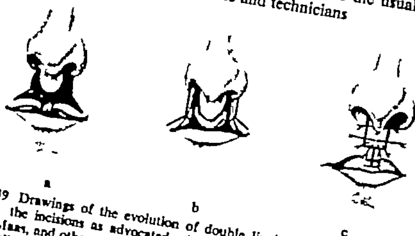


Fig. 449 Drawings of the evolution of double lip incisions. *a* Double harelip operation the incisions as advocated with slight variations by von Langenbeck, Mirault, Maas, and others. *b* The method of adjustment in accordance with the incisions outlined in *a*. *c* The sutures placed to correspond with the incisions and method of adjustment as outlined in *a* and *b* This method of operation creates an ugly deformity by making the lip too long and should be avoided.

It is essential to consider the character the displacements and the immediate part that the tissues in this congenital malformation should and must play to accomplish an ultimate desirable result.

One must evaluate these considerations in both the cleft lip with the premaxilla in its normal relationship to the alveolar arches and, also, in the various degrees of anterior displacement. The purposes of lip closure should be the same Some of these seem to be the essential psychic effect on the parents but the other more important ones are the immediate health of the child and the ultimate more basic one of moulding of the bony supporting arch during the period of development until the bone defects can be safely and properly repaired without suspension or retardation of this development. The latter is an extremely important consideration which may well change the present and long-existing attitude toward the time and manner of this reconstruction.

The tissues of the cleft lip and the consequently distorted nose permit, apparently the required conservative surgical trauma for their recon

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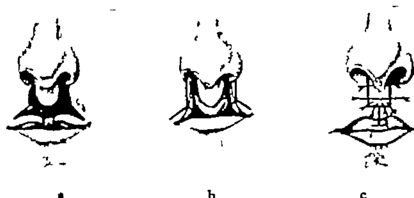


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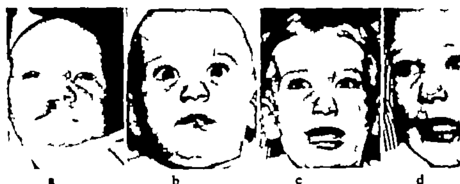


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Fig. 448 Case II repaired in a similar manner with different suture material.

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The method of Langenbeck or some of the several modifications of this have been generally followed for many years Several of these are presented and briefly discussed to demonstrate their various purposes and to permit their appraisal in relation to the secondary correction which is inevitably necessary for a desirable end result.

Langenbeck's procedure pictured in Figure 449 (p 661) makes a lip much longer than the normal, which is a definite cosmetic disability The described changes in incision made by Maas, Hagedorn and others were efforts to avoid this objection.

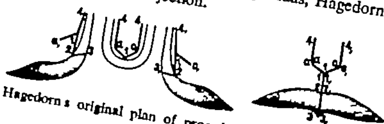


Fig. 450 Hagedorn's original plan of procedure in double cleft lip repair presented in 1884

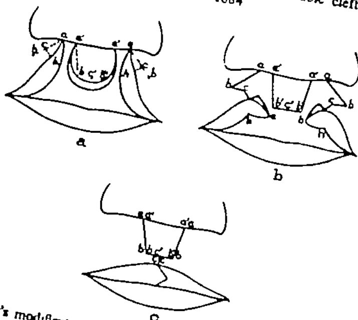


Fig. 451 Barsky's modification of Hagedorn's procedure presented in 1938 (See p. 665 for discussion.)

Hagedorn's procedure utilizes the same incisions on each free lip border which he uses on the single cleft portion to produce his rectangular flap (see p 663) The original drawings of his reported procedure in 1884 are presented in Figure 450 It has the same objection of added lip length if the prolabial skin which is needed for secondary nasal reconstruction is not shortened

The next procedure to gain a large following was that of Federspiel. This is practically identical with the original Langenbeck procedure except for slight variation in the location of the incision. The procedure

struction without a sufficient interference with blood or trophic nerve supply to retard or inhibit their full development. This is not true however with the supporting bony structure

The frequent malocclusions resulting from retruded, partially developed alveolar processes, misplaced upper teeth and asymmetries seen in routine practice furnish gross clinical evidence of the result of disturbed blood supply in the growth centers of these structures. The same observations apply to the vomer and supporting septal structures.

Several surgeons with much experience with this type of surgery over a period of years have discussed their observations on large groups of patients fourteen years or longer after palatal corrections during infancy or early years of bone development. They report that a large percentage of these need secondary corrections and other care

It seems probable that these clinical observations and the results of some exhaustive statistical data accumulating in several large researches may change entirely the present judgments as to the proper time for repair This may well be deferred until the end of the period of facial bone development with great improvement in both the functional and cosmetic results.

The cosmetic psychic and functional value of early lip closure is obvious Its orthopedic value in the correction of premaxillary clefts and vomerine overdevelopment as seen in the protruding premaxilla is equally clinically apparent.

The prolabium in these maldevelopments does not belong in the lip It consists of covering skin and connective tissue. It is part of the skin covering of the columella and should be replaced there in the correction of double clefts where the premaxilla is in its normal location in the alveolar arc and the end of the nose is reconstructed. It is possible and desirable in many such cases to close the lip in a single approximation line.

This is not possible, however in cases of a protruding premaxilla which results from either a single cleft and fixation to the opposing alveolar process or double cleft with overgrowth of the supporting vomer The prolabium becomes an essential part of the tip repair with no primary effort to correct the short columella with a retracted tip the horizontal nostrils and the widespread alae (See Secondary Lip and Nose Corrections p 628)

The repaired lip retards the growth of the vomer and permits normal alveolar development ultimately to place these segments in position for repair

Procedure It has been previously stated that there has been little change in the technical procedure for more than seventy five years except small ones determining the length of the lip from the prolabial to the mucocutaneous border and the approximation of the vermilion The objective is good muscle and skin anchorage to the prolabium in the central lip a proper length a normal vermilion and an acceptable cosmetic result pending and contributing to secondary lip and nose correction

The method of Langenbeck or some of the several modifications, of this have been generally followed for many years Several of these are presented and briefly discussed to demonstrate their various purposes and to permit their appraisal in relation to the secondary correction which is inevitably necessary for a desirable end result.

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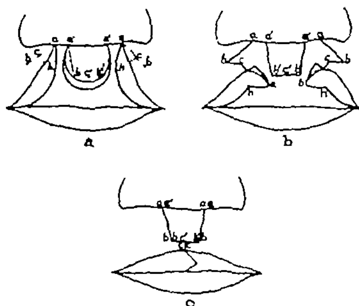


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The next procedure to gain a large following was that of Federspiel. This is practically identical with the original Langenbeck procedure except for slight variation in the location of the incision The procedure

does not interfere in any way with the malformed nose, but does definitely result in good closure and an acceptable temporary cosmetic result. This not only does not interfere with the secondary nasal correction, but contributes to its possibilities.

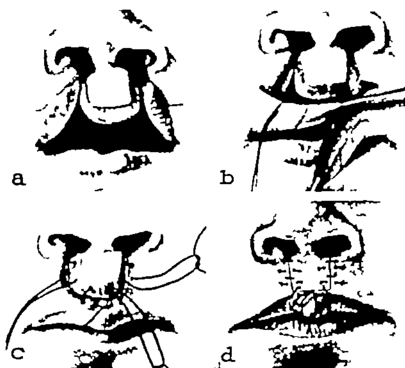


Fig. 452. Federspiel's modification. *a* The lines of incision. *b* Lip incisions made and plain catgut suture placed in the mucous membrane; dotted lines indicate excision of excess lip tissue. *c* Plain catgut sutures (0000 or 000) in the muscular layers. *d* On-end mattress sutures approximating the skin borders. (See p. 663 for detailed discussion)

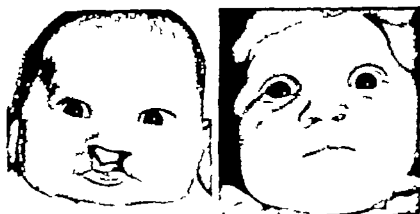


Fig. 453 Case III Federspiel's procedure (See p 661 for detailed discussion)

An example of this correction is presented in Figures 452 and 453 (p 664) The lip structure is acceptable, and its apparent length is an optical illusion This will change to a desired appearance when the alar attachments are changed the tip elevated, the columella lengthened and its lip attachment changed to a normal curve merging with the lip at a proper point.

A more recent contribution is the geometrically exact procedure of Barsky which permits surgical control of lip length good vermilion closure and so forth It does this, to some extent, at the expense of the secondary treatment of the columella (Fig. 451, p 663)



Chapter XI

CERVICOPLASTY

SCAR CONTRACTION FOLLOWING BURN

The degree and area of a burn determine not only the amount of scar formation, but also the functional and cosmetic disability created by the fixed contraction of the fibrous tissue. Immediate proper care and closure of the surface with split skin prevent disabling contractions in the lesser degrees of burn, but cannot and do not prevent ultimate marked contraction in the greater degrees. The graft is only a primary management which requires secondary supplement.

The use of "pinch" grafts or deep grafts on exposed mobile surfaces is inexcusable. They offer no hope of fine cosmetic result and are surrounded with too much scar for a desirable functional one.

The following cases are presented to emphasize these statements and to discuss acceptable methods of reconstruction.

Case I. Median Contraction Scar; Obliteration of Chin-Neck Line; Atrophy and Arrested Development of Mental Portion of the Mandible; Slight Ectropion of the Lip; Limitation of Movement, and so forth. Good results were accomplished by Z-plastic operation, implantation of cartilage in the mental region, and implantation of a dermal graft to restore contour and motility to the soft parts of the chin and lip (Fig. 454).

It is presumed that proper care of the patient from the time of injury or burn until repair is completed would preclude ultimate deformity. It may result, however, from loss of bone of the mandible, loss

of the surface and infection in the neck and demand the attention of the surgeon



Fig. 454 Case I contraction caused by cervical scar *a* and *b* Contraction caused by cervical scar obliterating the chin neck line limiting the motion of the head, and resulting in atrophy and maldevelopment of the mental portion of the mandible *c* and *d* (patient used face powder for these photographs) the result of Z plastic operations on the neck; scar removal from lower lip cartilage and dermal graft to the mental area of the mandible. The cheek, neck and chin scar may be eliminated by multiple excision, the ectropion of the lip by a Z plastic or a rotated flap

Procedure STAGE 1 Design a Z flap with the central member of the Z splitting in linear fashion the midline of the scar fold which extends from chin to clavicle. Cut the lateral members of the Z at an angle of 60 degrees with its central member (p 221) Make two such

lateral flaps on each side of the central member Elevate the triangular flaps included between these incisions. Freely undercut the skin and subcutaneous tissue about their bases Obtain complete hemostasis. Transpose these flaps and suture the points of the upper flaps as far laterally as possible to produce a chin line Adjust the edges of the skin and approximate them with interrupted horsehair sutures. Dress with gauze and a firm bandage. Remove all the stitches except those at the points of the transposed triangles, on the second day Support with strips of gauze applied with collodion

STAGE 2. A minimal interval of one month is allowed to elapse between Stages 1 and 2

Excise the scars bordering the upper transposed triangles. Dissect and elevate the included flaps and the bordering skin and subcutaneous tissue Draw the points of these flaps as far laterally as possible without impairing their blood supply Mark the contact of these points on the surrounding skin of each side and open the skin to this point Suture the points of the flaps in these newly created angles and close the approximating skin edges of the flaps with interrupted horsehair sutures The remainder of the management in this stage is the same as that in Stage 1

The purpose of elevating and extending these triangular flaps farther laterally is to increase the tension of the skin beneath the jaw and further to improve the curved line from chin to neck It is frequently necessary to repeat this maneuver a third time in order to obtain a desired result.

STAGE 3 The minimal interval between Stages 2 and 3 is three weeks.

Undertake reconstruction of the mental region Make a mask of the face Make with modeling material a suitable chin on the mask Obtain from this the dimensions and contours of the desired addition to the mental region of the patient.

Make two vertical incisions, 3/4 inch (almost 2 cm.) long, beginning at the lower margin of the mandible beneath the angles of the mouth Extend these incisions to the periosteum Undermine the skin and soft tissues above the periosteum between the two incisions and up to the sulcus of the lip Extend this undermining a short distance laterally from each incision Shape a piece of preserved rib cartilage to the dimensions and contour obtained from the model on the mask Insert this in the tunnel and close the incisions with interrupted sutures of horsehair Apply a smooth firm gauze dressing with strips of adhesive tape Remove the cutaneous stitches on the second day Replace the dressing at appropriate intervals for ten days

STAGE 4 The minimal interval between Stages 3 and 4 is six weeks. Open the scars of the incisions made in Stage 3 elevate the skin and subcutaneous tissues between them without interfering with the implanted cartilage Obtain skin for a dermal graft from a distant surface of the body (p 135) Remove its epithelium

Draw either a single or double layer of the graft into the prepared tunnel Close the incision with interrupted stitches of horsehair Dress and manage as for Stage 3

Case II Third Degree Burn; Split Skin Graft. This case is presented to demonstrate the futility of permanently repairing the burned area

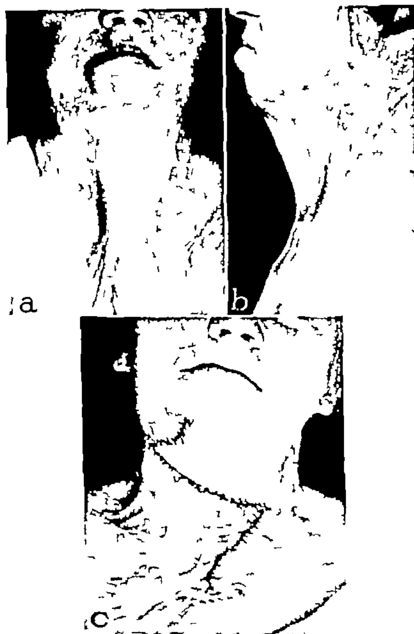


Fig. 455 Case II, split skin graft, scar contracture. (See text for detailed discussion.)

with split skin. It neither controls the fibrous tissue formation in the injured fascia and muscle its ultimate contraction and behavior nor does it in any way match its bordering skin It is both a functional and cosmetic failure (Fig. 455, *a*, *b*)

degrees along the clavicle and the upper arm mesially across the back of the neck.

Elevate the flaps and the skin bordering the upper incision Excise the underlying scar

Transpose the flaps and suture with 00000 Dermalon Approximate the upper skin border under traction excise the excess and suture with 00000 Dermalon.

The result is presented in Figure 456 *c* The remaining submaxillary neck scar may be removed by multiple excision

Case IV Contracted Cervical, Facial and Lip Scar from a Poorly Managed Burn. This case is presented here for the sake of emphasis. It is discussed in detail under Ectropion of the Lip (Cheiloplasty p 617)

The unmanaged scar contraction in early youth inhibited development of the mental part of the mandible obliterated the chin-neck line and caused total ectropion of the lower lip and marked psychic changes.

The accomplishment of the result presented in Figure 457 *c* was obtained as noted above

Case V Burn Scar Contraction of the Left Upper Chest, Arm, Neck and Ears; Granulating Frontal Scalp Occipital Ulcer; Pinch Grafts; Head Fixed to Left Chest. Scoliosis. The author cannot resist criticism of the weeks of management of this case until the time of this examination The condition is presented in Figure 458 *a b* (p 673)

The child suffered a marked third degree burn of the left upper chest upper left arm, neck, frontal area, ears, occipital scalp and back There was a second degree burn of the lateral neck and lower cheek *on both sides*

The choice of pinch grafts for covering of the neck and arm was bad judgment The time required for healing, the necessary scar formation and so forth, should preclude such a choice. Further many of them must have failed and the neck allowed to granulate heal and contract. The frontal area the shoulder several areas on the chest and the occiput are granulating surfaces after the time required for scar formation and contraction old enough to fix the head to the left. The one compensation is sufficient stretching of the second degree scarred skin on the right neck to permit its use in Z plastic and multiple excision in correction of the condition.

Procedure STAGE 1 EXCISION OF SCAR IN LEFT AND ANTERIOR NECK RELAXATION OF HEAD AND NECK. Make an incision from the anterior border of the trapezius forward below the ear along the normal skin border adherent in the neck beneath the chin around the contracted scar on the right neck down to the clavicle along the left clavicle to the trapezius and up along its border to the point of beginning Excise completely all the included scar

Overcorrect the position of the head to the right side Cover the entire neck area with split skin from the abdomen. Baste in position and dress.

It required two and a half drums of skin to cover this area

An interval of three weeks elapses

STAGE 2. EXCISION OF OCCIPITAL SCALP ULCER AND NECROTIC BONE There is a crater like ulcer 1 inch (2.5 cm.) in diameter surrounded by a border of soft scalp tissue of similar width The external table beneath this presents a well-demarcated necrotic area that appears like a beginning sequestrum.

Excise the scalp with a circular incision around the involved border of the ulcer

Remove with a chisel the demarcated outer occipital table. Curet thoroughly the diploic and marginal bone



Fig. 458 Case V *a* burn scar contraction of the upper chest, arm, neck and ears, with head fixation *b* granulation of the frontal scalp occipital ulcer scoliosis; pinch grafts. (See p 672 for detailed discussion.)

Make a curved incision from the lateral border of the excised defect upward and medially to outline a flap of sufficient width and length to rotate and close the defect Make a second incision from the inferior border of the defect mesially to outline the base of this flap and permit its rotation

Freely elevate the flap and its bordering scalp from the periosteum

Rotate the flap and suture the approximating borders with 00 Dermalon Insert a small Penrose drain and dress

An interval of six months elapses.

STAGE 3 BROAD, CONTRACTED SCAR BAND FROM THE MANDIBLE TO THE CLAVICLE PULLING THE HEAD TO THE LEFT SIDE Outline and incise a Z with the scar band as its central member The upper lateral arm follows the inferior border of the mandible and crosses the sterno-

mastoid muscle The lower inferior arm parallels the clavicle across the median line of the neck

Elevate the included flaps to the maximum extent of safe blood supply in this grafted skin surface Freely elevate the bordering skin Excise all scar

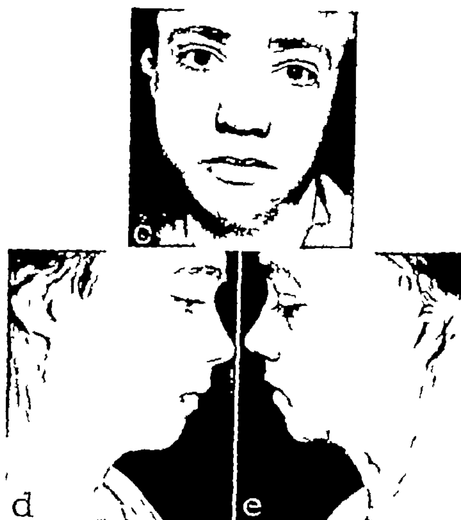


Fig. 458 (continued) End result of the procedure (See p 672 for detailed discussion)

Transpose the flaps Make maximum safe traction on these graft flaps and their bordering scarred skin. *Continue the incision under the mandible on the right side to permit approximation of the transposed flap and create the chin-neck line*

Suture with 00000 Dermalon and dress

An interval of three months elapses

STAGE 4 CONTRACTED SCAR BAND FROM THE MASTOID TIP TO THE *CLAVICLE* *Make Z plastic flaps* as above Excise all scar

An interval of one month elapses.

STAGE 5 Contracted scar bands from the mental part of the mandible to the sternum are appearing Perform a Z plastic as above

An interval of seven months elapses

STAGE 6 CONTRACTED SCAR BAND FROM THE MANDIBLE TO THE CLAVICLE 1 INCH (2.5 CM) LEFT OF THE MEDIAN LINE There are two such bands from the angle of the jaw to the clavicle Proceed as above

An interval of three years elapses

STAGE 7 CONTRACTED SCAR BAND FROM THE LEFT EAR LOBE TO THE SHOULDER ON BOTH SIDES 3 INCHES (7 5 CM) LONG Again proceed as above

An interval of five and one half years elapses.

STAGE 8 CONTRACTED SCAR BAND FROM LEFT EAR LOBE DOWN THE SIDE OF THE NECK. The reconstruction of the ears had little attention during this period. The initial stages of a plan of reconstruction have been completed on the right side Availability and economic situation does not permit management at present.

The result after a period of ten years is presented in Figure 458 *C D E*

Case VI. Scar Contracture and Keloid with Fixation of Chin to Chest. This case is an extreme example of *bad management of a third degree burn*. The scar involved the anterior surfaces of the chest and abdomen and extended to the axillary lines.

A pedicled flap was used to control subsequent formation of scar and to provide the desired cosmetic result. The source of this flap was of necessity the back. The dimensions of a flap to provide all the necessary material demanded careful consideration. The defect produced by removal of a contracted scar and by retraction of its released borders never ceases to be astonishing The defect in this instance was particularly so A flap 6½ inches (16.5 cm) wide was required to repair it (Fig. 459 *e*) More than half of the total width of the covering skin of the back was required The length of the pedicle and flap must be sufficient to permit the flap to cover the defect without tension when the pedicle is swung around the neck.

Time is the surgeon's friend in cases of the type. The longer the intervals within reason between the stages of reconstruction, the more certainly it will proceed. The surgeon *must not* be unduly influenced by the desires of the patient or by the demands of his situation.

Procedure Preparation of Pedicle and Flap STAGE 1 Incise the sides and distal end of a rectangular flap of sufficient length and width with its base on the left shoulder Carry the incision through the skin and subcutaneous fat. Dissect the middle third of the flap free from the fascia Freely undercut the skin and fat bordering this area. Pass two Halstead relaxation stitches (Fig. 134) of heavy catgut through the under surfaces of the bordering skin to approximate its edges Close with interrupted horsehair stitches. Roll the edges of the free flap together and approxi-

mate with interrupted horsehair sutures (Fig. 459 *b*) Close the line of incision around the flap with interrupted sutures of horsehair This border *incision cuts off lateral blood supply* to the flap Dress with gauze applied with adhesive tape

The minimal interval between Stages 1 and 2 is one month.

STAGE 2 It is apparent that the flap cuts across the entire blood supply of the area Considerable time will be required to enlarge the circulation from the base through the pedicle to and in the flap sufficiently *to provide an adequate supply of blood* This must be accomplished by careful delaying of the flap (p 17) Incise the borders and end of the *distal third of the flap* Dissect the skin and fat from the fascia Return the flap to its bed. Approximate the edges along the line of incision with interrupted sutures *This cuts off the blood supply from the base and borders* of the flap and forces it to depend on circulation from above

STAGE 3 A lateral half of the flap from the end of the tube to the distal end, is treated as described under Stage 2

The interval between this and the former stage again is three weeks.

STAGE 4 DELAY OF FLAP The opposite lateral half is treated as de*scribed under Stage 3*

Again the interval is three weeks.

*STAGE 5 DELAY OF FLAP The entire lower half of the flap is man*aged still in the same way

The interval remains three weeks.

STAGE 6 DELAY OF FLAP In the case under consideration the en*tire flap was elevated It enjoyed good blood supply in its normal posi*tion but became cyanosed when the pedicle was elevated It was returned *to its bed on this and on a subsequent occasion three weeks later*

Repair of Neck STAGE 1 Make an incision at the junction of the scar and the skin of the cheek and chin beginning on the right side and extending from the attachments of the scar to the skin over the mandible on the left side Dissect the scar tissue from the area beneath this incision to release the chin This dissection should be carried to the fascia and should completely remove the scar in the neck Release of the mandible and elevation of the head leave the *entire neck without covering*

Excise the borders of the scar beneath the clavicle to obtain the approximating surface for the transposed flap Elevate the flap Incise

Fig. 459 Obliteration of the anterior aspect of the neck fixation of the head. *a* Extensive *hypertrophied scar and keloid obliterating the neck and fixing the chin* to the chest below the clavicle: the scar covers the chest to the umbilicus and to both axillary lines. *b* Delayed tubed pedicled flap $6\frac{1}{2}$ inches (16.5 cm.) wide based on the shoulder and cut across the blood supply *c* The scar obliterating the neck has been excised and the head released the tube pictured in *b* has been swung around the neck, and the flap on *its distal end utilized to cover the dissected por*tion partial incisions in the tube at the point of ultimate amputation the part of the tube attached to the neck flap will be opened and utilized to complete the repair *d* and *e* End result of this procedure hypertrophied scar borders the transplanted flap



Fig. 459

the median and lateral scar lines of the base of the pedicle and slightly undercut the bordering skin of the base This will permit greater rotation of the pedicle Swing the pedicle across the back of the neck to bring the flap into the cervical defect (Fig. 459 *c*) Tack the flap to the underlying fascia along the line of junction of chin and neck using a few interrupted catgut sutures These sutures should be passed along a line in the flap which permits distribution of its upper part over the chin without tension This suture line is important in obtaining a pleasing chin line. Approximate the borders of the flap with interrupted horsehair sutures Dress with gauze applied with a bandage which in turn is fixed with strips of adhesive tape

The skin defect in the back resulting from elevation of the flap is closed by rotating appropriate skin flaps

The minimal interval between Stages 1 and 2 is one month.

STAGE 2 The transplanted flap has acquired a considerable new blood supply during the interval from invasion and organization of vessels about its border and its base This flap will ultimately become the source of blood supply for that part of the pedicle which will be amputated and opened to complete repair of the neck Severance of the blood supply through the pedicle begins at this stage. It parallels delaying of the distal flap in the manner of building up a proper blood supply from the opposite end of the pedicle

Determine the length of the pedicle to be utilized in completing the repair Cut into the pedicle for a short distance on opposite sides of the proposed line of amputation (Fig. 459 *c*) Cover with a gauze dressing applied with adhesive tape Repeat this procedure at intervals of ten days until the pedicle has become completely severed. Excise the scar along the suture line of the pedicle and spread it out to complete repair of the lateral surface of the neck Approximate its borders with interrupted sutures. Amputate the excess remainder of the pedicle and adjust its base into the surrounding skin.

The result of these procedures several months after completion is presented in Figure 459 *d e* (p 677) The hypertrophied border scar will probably flatten and soften in a few months

Case VII Burn Scar of Lower Cheeks, Lower Lip and Chin Neck, Chest, Axillae and Adjacent Back; Anterior Fixation of the Head Total Ectropion of the Lower Lip· Traction Displacement of the Lower Central and Lateral Teeth; Obliteration of Chin-Neck Line A pedicled flap with a thin fat layer of sufficient width and length to cover the entire involved neck is essential to a desirable repair The only available skin is on the arms and the middle of the back It was desirable not to add any scar to the shoulders and arms of this little girl

Consequently the base of the pedicle is poorly placed (Fig 460 *c* p 679) The entire flap is cut across the direction of blood supply Its width is more than a third of the total width of the back It obviously requires adequate delay

Procedure STAGE 1 OUTLINE AND CONSTRUCTION OF THE DESIRED TUBED PEDICLE FLAP The length of the tubed pedicle must be ade quate to permit rotation into desired position on the neck

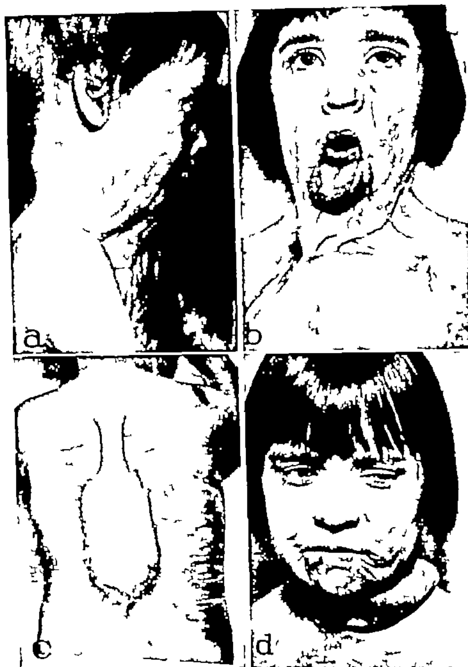


Fig. 460 Case VII burn scar contractions tubed pedicle flap from the back. *a* and *b* The original condition *d* the tubed pedicle flap on the back *c* the approximation of the tubed pedicle flap to the right neck.

Incise its borders as presented in Figure 460 *c* Elevate the upper third of the flap and its bordering skin Slide and approximate the bordering skin with Halstead traction sutures. Roll the pedicle skin into

a tube and suture its approximating borders with 00000 Dermalon. Dress

An interval of one month elapses.

STAGE 2 DELAY OF FLAP Incise and elevate the lower third of the flap Suture and dress



Fig. 460 (continued) Result of Z plastic and multiple excision. (See text for detailed discussion.)

An interval of three weeks elapses

STAGE 3 DELAY Incise and elevate the right lateral half of the flap from the distal end of the tube to the tip of the flap Suture and dress

An interval of three weeks elapses.

STAGE 4 DELAY Repeat the procedure of Stage 4 on the left half of the flap

An interval of three weeks elapses.

STAGE 5 Elevate and delay the entire lower half of the flap

An interval of three weeks elapses

STAGE 6 ELEVATION OF THE ENTIRE FLAP The blood supply of the flap is satisfactory until the pedicle is turned about the neck. Return the flap to its bed and delay

An interval of three weeks elapses.

STAGE 7 NECK REPAIR ROTATION OF THE FLAP Incise the skin along the inferior mandible line. This releases the downward and lateral lip pull It permits dissection of the lateral borders of the lip skin and the return of the vermilion to approximately its normal location. It releases the chin from the scar pull It leaves much of the central and bordering neck bare

Incise along the clavicles and excise the scar between the two incisions.

Elevate and rotate the pedicle flap into its neck approximation Suture its subcutaneous surface to the neck tissues along the chin neck line Approximate the borders of the flap to the incised borders of the neck defect with 00000 Dermalon. Dress (Fig. 460 *d*)

Elevate the skin bordering the bed of the flap on the back Slide and approximate this with traction sutures and 00000 Dermalon Dress.

An interval of two to three months elapses

STAGE 8 AMPUTATION OF THE PEDICLE. Partially incise opposite sides of the pedicle (see Fig. 459 *c*) Repeat this at intervals of ten days until it is safely completed Incise the scar of the proximal end of the tube to its base. Adjust this base skin on the back

Incise the remaining distal end of the pedicle and adjust in the neck (Fig. 460 *e, f g h*)

An interval of three months elapses.

STAGE 9 EXCISION OF LIP AND CHEEK SCAR

Case VIII. Burn Scar; Maldevelopment of Chin; Ectropion of Lip. This patient at the age of two years had a second and third degree burn from hot grease involving the soft tissues over the right mastoid, around the lobe of the ear to the level of the canal, thence down the cheek to the commissure of the lips and below this line beneath the mandible for 1½ inches (3 75 cm.) There was a smaller area of burn on the left of the chin and on this cheek.

The contracture of this burned area produced marked ectropion of the lower lip and distortion of the right commissure and its traction around the mandible inhibited development of its mental portion (Fig. 461 *a b c* p 682)

The plan of the corrections obviously consisted in the introduction of adequate skin into the lower lip to permit restoration of the free margin of the lip, construction of a desirable chin, reconstruction of the ear lobe, and removal of the scar from the chin and neck.

Procedure STAGE 1 RELAXATION OF THE LOWER LIP CORRECTION OF THE ECTROPION RELAXATION OF CONTRACTION LINE ALONG THE RIGHT MANDIBLE AND RECONSTRUCTION OF THE RIGHT EAR LOBE An adequate flap was designed and incised on the left cheek and neck to release the lower lip skin. This flap was based superiorly and was 2¼ by 1¼ inch (6 by 3 cm.) wide at its distal end (Fig. 461 *e*)

The junction of the vermilion and skin was incised from angle to angle. The vermilion was dissected free, and all underlying scar was excised.

The flap and its bordering skin were elevated on the left cheek. The skin borders of the defect resulting from elevation of this flap were advanced and sutured, thus increasing the flap length about 2 inches (5 cm.)

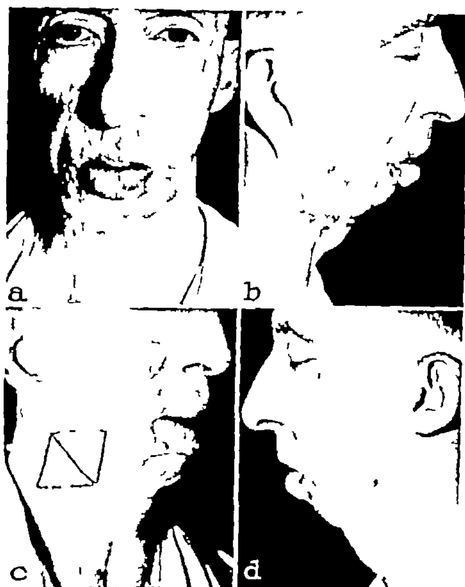


Fig. 461 Case VIII burn during childhood maldevelopment of the chin neck line ectropion, ears Z plastic, multiple excision, and rotated interpolated flap. (See p. 681 for detailed discussion.)

The flap was rotated 90 degrees and sutured to the vermilion and the bordering skin of the defect.

A Z was designed and incised on the right cheek with its central member (1¼ inches—3 cm.) on the scar pull along the mandible its anterior arm on the cheek, and its posterior arm on the neck (Fig. 461 c). The incised flaps and bordering skin were elevated. The flaps were rotated and sutured with 00000 Dermalon, thereby increasing the skin length over the mandible about 7/8 inch ([illegible] cm.) and

permitting the beginning of multiple excision of the face and neck scar. The location of the tips of these flaps under traction began to establish the chin-neck line.

Diagonal incisions were made about ⅛ inch (3 mm.) from the anterior and posterior attached borders of the right ear lobe and joined at a point ¼ inch (6 mm.)



Fig. 461 (continued)

inferior to the stretched, inferior attachment of the lobe to the cheek. This skin and the lobe were elevated. This bordering skin was incised and sutured to readjust the lobe to its normal shape. The bordering skin of the remaining defect was elevated and sutured with 00000 Dermalon.

An interval of three months elapsed.

STAGE 2. CHIN NECK LINE, BUCCAL MUCOSAL EXCISION TO FURTHER CORRECT THE

The junction of the vermilion and skin was incised from angle to angle. The vermilion was dissected free, and all underlying scar was excised.

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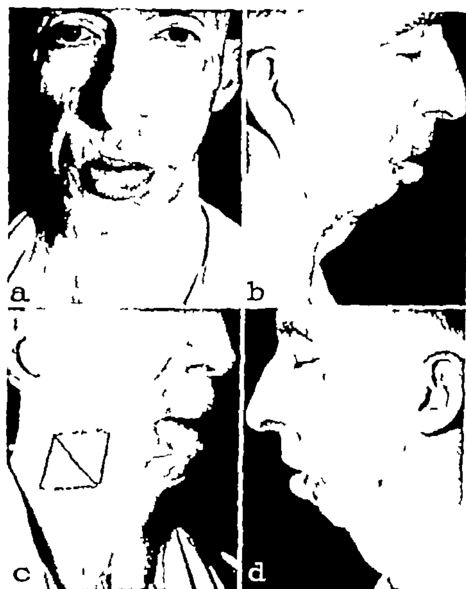


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Fig. 461 (continued)

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An interval of three months elapsed.

STAGE 2. CHIN-NECK LINE, BUCCAL MUCOSAL EXCISION TO FURTHER CORRECT THE

LIP ECTROPION Z PLASTIC AT THE COMMISSURES OF THE LIPS TO RESTORE THE NORMAL MOUTH OPENING. A Z-plastic was performed at both commissures to increase the lip opening to its normal horizontal extent.

An elliptical incision was made concave downward, across the midline of the lip mucosa from commissure to commissure. The upper flap was dissected to the mid-horizontal line of the vermilion avoiding the labial artery. The excess buccal mucosa was excised and the flap sutured along the original incision line with 0000 silk.

Z flaps were designed incised and shifted in the submental and bordering neck areas to increase the chin-neck line (see p. 221 also Fig. 470 p 617)

An interval of three months elapsed.

STAGE 3 RECONSTRUCTION OF THE CHIN. The submental scar of the previous Z plastic was incised. The soft tissue was elevated above the periosteum of the mandible between the mental foramina.

Two thick, preserved rib cartilages were carved and fitted together to produce the desired mental contour These were not adequate to furnish the total desired anterior chin protrusion, but were the total safe initial implant at this stage After encapsulation and complete organization, a similar addition was required.

The two carved pieces were sutured together with several 0000 plain catgut stitches.

Insertion was made above the periosteum. The soft tissue was sutured with a few 0000 plain catgut stitches and the skin was approximated with 00000 Dermalon.

The surface was covered with two or three layers of fine mesh gauze impregnated with Furacin ointment. A mould of dental modeling compound (stent) some fluffed gauze and a Barton bandage were applied

Case IX. Burn of Neck and Lower Face Tubed Pedicle Flap Repair This case is presented to emphasize the "don'ts" as well as to indicate the things to be done under the circumstances. It permits, also indication of what might have been done simply and satisfactorily in the initial plan of reconstruction.

This patient had suffered a third degree burn of the right ear the lower half of the right face and upper neck and the submental area five years before this examination. All this time except two short periods, had been spent in a large teaching clinic.

The plan and execution of this repair was such that the author cannot resist its critical discussion for the value that this should have to the reader The result of this long effort is presented in Figure 462, *a b e f* (pp. 685 686)

The initial effort to transfer the desired skin for repair was a tubed pedicle flap from the back. It is assumed that this was conceived to preserve the neck and chest of a young girl. The location of the flap with its base on the lower neck and cut diagonally on the center of the back across the lateral blood supply is hazardous under the direction of a most experienced, patient plastic surgeon who appreciates thoroughly the necessity of tissue "delay" This flap was rotated to the anterior neck *and gangrened. The many stitch scars speak for the use of heavy material tightly tied* and left in position long after a proper time for removal.

The second and subsequent efforts to correct a cosmetic disability with no functional disturbance ruined the lower neck, breast and upper arm of this girl (Fig. 462, *e f* p. 686) The quality and color of the skin brought into the face and neck has no place here except as a procedure of necessity It creates a different but just as distressing, cosmetic disability as the burn scar for which the patient sought relief *The surgeon not only failed to meet his responsibility* but added to the patient's damage

It is evident from the quality of skin seen on the left midneck and lateral neck and the lower right neck (Fig. 462 *a, b* p. 685) after these destructive surgical efforts, that a pleasing reconstruction could have been accomplished by Z plastics and multiple excision with minimum effort upon the part of both surgeon and patient

The patient now presented, *in addition to the back, arm and breast scar* two large full thickness flap grafts beginning at the lobule of the right ear and extending for

ward to the middle of the chin. These were about 2¾ inches (7 cm.) in diameter They were surrounded by hypertrophied stitch scars. There was an elevated contrac tion scar down the right neck from the mental foramen to the manubrium. It de pressed the right oral commissure. There was an asymmetry of the two mandibular face and neck areas as result of fat under these grafts and the scar contraction in the right neck.



Fig. 462. Case IX burn scar badly planned and managed tubed pedicle flap from the chest and the back poor application. *a* and *b* The original condition *c* and *d* the present condition after Z plastic and multiple excision.

Procedure STAGE I EXCISION OF GRAFT FAT ELEVATION OF COMMISSURE OF LIPS. The normal skin was incised above and below the stitch scars around the superior and mesial borders of the graft. The included scar was excised. The superior half of the flap was elevated by dissection of the fat from the corium. The underlying fat was excised. The flap was rotated upward and backward to release the traction on the angle of the mouth, and sutured with 00000 Dermalon.

An interval of eight months elapsed

The neck skin was reflected upward above the hyoid bone. The duct tract and all blue-stained tissue were dissected to the hyoid and the tissues on its body surfaces were separated.

Radicals of the principal duct entered the body of the hyoid. It ran, posterior to the hyoid, to the tongue.



Fig. 466. Case II: thyroglossal cyst. (See text for detailed discussion.)



Fig. 467. Case III: thyroglossal cyst in the cricoid area. (See p. 693 for detailed discussion.)

The stained areas of bone involvement may be cleared with a small finger-operated twist drill, but the author prefers, in most cases, to excise the involved body of the bone. There have been recurrences after the drilling technic.

Excise the central two thirds of the body.

Excise the duct and blue-stained areas in the tongue. These extended about midway to the foramen caecum.

Suture the tongue with 00000 plain catgut. Pass 00 plain catgut sutures through the lateral remnants of the hyoid body and approximate

these ends. Approximate the attached muscles with 00000 plain catgut. Suture the skin with 00000 Dermalon Dress

These cysts or fistulas may appear below the thyroid gland, over the thyrohyoid membrane above the body of the hyoid bone, or below the mylohyoid muscle

Those occurring below the hyoid body usually have ducts and/or radicals of sufficient length to permit a simpler satisfactory management. These are dissected to the hyoid as discussed above They are tied tightly together at their distal end with No 3 silk The fibers of the middle constrictor or mylohyoid muscle are bluntly separated a long probe carrying the silk ligature is passed through into the oral pharynx traction on the ligature draws the duct mass into the hypopharynx, and the ligature is fastened to the cheek or around the ear The tight ligature sloughs in two or three days The duct secretes in the pharynx as it did originally at the fistulous opening.

The procedure has produced satisfactory results over a period of years It was described originally by Koenig

Case III Thyroglossal Cyst between the Mylohyoid Muscles. This cyst occurs in a common site which is also the occasional location of an accessory thyroid mass which has the same origin in a segment or "rest" of the original thyroglossal strand. These rests contain squamous and ciliated cells lymphoid structure and so on as well as the thyroid tissue

The management is excision as described above (Fig. 467)

Thymopharyngeal Duct Cysts—Branchial Cysts

It is generally taught and accepted that lateral cervical cysts and fistulas anterior to the sternomastoid muscle and to or below the level of the hyoid result from failure of obliteration of the branchial clefts the majority of them originating in the second cleft.

Cysts may develop from any point from the external ear to the wing of the sphenoid. They may lie within the parotid gland with several sacculations some of which appear posterior to the external ear

The required management of those lying external to the parotid gland is evident. The author knows of no routine successful management of those involving the substance and depth of the parotid gland. Their successful management would almost certainly result in destruction of the facial motor nerve

Further the author is convinced that we have been mistaken in our conception of the source and development of these cysts and some of our beliefs about median—so-called thyroglossal—cysts and fistulas.

The meticulous and extensive research demonstrations of Wenglowski and a later analysis of the clinical problem based on these research findings by Myers and others seem to leave no doubt as to a proper explanation

The cysts and fistulas develop along the "thymus corridor" The thymus anlage is in the third pharyngeal pouch Two processes are

formed from the low lateral wall of the fourth pouch which are the anlage of the lateral thyroid lobes The third pouch passes laterally into the third cleft. A depression forms downward and posterior from the angle of this pouch which appears to cross the thyroid anlage This is the thymus anlage

The later thymus duct runs laterally from the pharynx and slightly downward to the area between the ear lobe and angle of the jaw thence downward and forward medially between the sternomastoid line and the lateral surface of the thyroid, and on down to the sternum, where it terminates in actual gland substance This complete duct structure persists until the second or third month of embryonic development and is rarely present in later life

If the regression is not complete and the duct segments which occurs more often in the lower neck than in the upper these segmented parts may or may not cause later difficulties These rests are small canals which may become cysts They are variously lined with epithelium squamous or ciliated and sometimes mixed with lymphoid walls. The canal may remain complete An excellent example of such a sinus tract opening in the right neck on the anterior border of the sternomastoid above the sternal notch is reported by Blassingame. The superior end of this duct 5 cm long opened into the tonsil The course of a complete duct is always arched and this arch is constant below the angle of the jaw at about the middle of the posterior belly of the digastric muscle The upper part runs laterally and downward The lower segment that below the digastric, follows the anterior border of the sternomastoid to the sternal notch where the actual thymus gland begins. The part above the arch of the duct forms part of the third pharyngeal pouch

Case IV Thymopharyngeal Duct Cyst. This is a typical location and picture of the upper lateral cervical cyst. It lies anterior to the sternomastoid muscle and originates, apparently posterior and mesial to the ascending mandibular ramus and the gland

The patient aged eighteen, had a swelling in this area at the age of thirteen which persisted for three or four weeks. It returned again after a pharyngitis, persisted, and gradually enlarged. The tumor extended from 1 inch (2.5 cm) below the ear lobe to within the same distance from the clavicle (Fig. 468 *a* p 695)

Procedure A long collar incision was made in one of the neck creases (Langers line) across the middle of the tumor The skin and fascia above and below were elevated. The deep fascia was incised along the anterior border of the muscle

Much of the cyst content was aspirated to permit easier and safer dissection.

The mass lay on the carotid sheath and somewhat beneath the muscle It was dissected upward to its termination about ½ inch (13 mm.) behind and above the angle of the jaw

The fascia was closed with 00000 plain catgut and the skin with 00000 Dermalon.

The result of the procedure two years later is presented in Figure 468 *b*

Case V Thymopharyngeal Cyst. This is presented to demonstrate a different behavior and disposition of a cyst from the same source It occupies the bottom of the second cleft from its lateral to its mesial limit.



Fig. 468 Case IV thymopharyngeal duct cyst. (See p 694 for detailed discussion.)

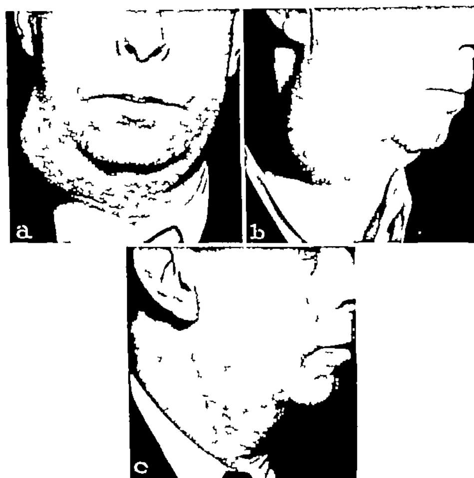


Fig. 469 Case V thymopharyngeal duct cyst. (See p. 694 for detailed discussion.)

It has been aspirated numerous times through a period of years. Its proper management is the same as discussed in the preceding case (Fig. 469 p 695)

Congenital Sinuses (Pits) of the External Ear

The origin of these pits is not certain There are marked differences of opinion which can be simply presented. One belief is that they result from inclusions from the first branchial cleft. The other is that they result from faulty union of the six tubercles described by His around the posterior end of the first cleft which fuse to form the external ear Arey states that the tubercles forming the ear are on the mandibular and hyoid arches

A recent review of the situation states that these sinuses are short, blind epithelial lined tracts about the tragus and on the external surface of the crura of the antihelix They may be either unilateral or bilateral, the former occurring about three times as frequently as the latter

The author s purpose is to discuss the clinical manifestations rather than the embryology of the lesion The interest is not in the blind tract with no secretion or an occasional drop of mucoid material but rather in the inflamed suppurating draining tract It has been previously stated that the author knows of no safe satisfactory management of those fistulas which invade the parotid gland and present multiple small cysts and racemose tracts. He has twice injected such tracts with methylene blue undertaken their surgical removal and abandoned the effort when it became evident that successful removal would involve the facial nerve

He has operated on such fistulas opening in front of the midpoint of the anterior helix and terminating behind the ear and on one such case opening below the tragus and terminating mesially behind the lobule Escharotic chemicals and boiling water do not seem to offer safe results in this situation

Dermoid Cysts

These rarely originate in the first cleft. Sublingual dermoids may originate from the ectoderm of the first arch which forms the lateral part of the root of the tongue

Incomplete union of the arches produces the mesobranchial space of His a defect in the middle line of the submental region Adhesion of entoderm to ectoderm here forms a membrane which may rupture and produce mesobranchial dermoids which lie in the root or base of the tongue in the midline and appear ventrally in the suprahyoid area.

Both embryonal layers are present in the lining when the mem branous septum has ruptured. The contents are usually sebaceous and may contain hair Those having a squamous-celled mucous membrane with a basal layer of columnar cells contain mucus

Case VI. Dermoid Cyst Containing Hair and Sebaceous Material. There had been a slowly growing mass, 3 inches (7 5 cm.) in diameter in the the submental

region for eight or nine years. The rounded borders blended into the soft tissue beneath the surrounding skin The skin over the mass was unattached.

Procedure A transverse, elliptical incision was made over the center of the mass. The skin-muscle fascial layers were reflected upward and downward to the borders of the mass.

These were separated vertically and the stretched muscle fibers retracted. The tumor was incised and aspirated. This contained caseous material some light brown fluid and hair It had a moderately thick, fibrous capsular wall

The capsule was dissected from the bordering tongue. This terminated about two thirds of the distance to the foramen caecum.

The bordering tongue tissue and the muscular tissue were approximated with 00000 plain catgut and the skin flaps with 00000 Dermalon. A dressing was applied. See Figure 470.



Fig. 470. Case VI dermoid cyst. (See text for detailed discussion.)

Hemangioma

The several considerations of hemangiomas were fully discussed on page 234 Management of the types and complications were de scribed in detail on page 234 A case is presented here to emphasize the universal distribution and management as well as to present the differ ential diagnosis of fluctuating masses in this locality (Fig 471 p 698)

A collar incision was made over the center of the swelling, the vas cular mass separated until its afferent and efferent vessels could be ligated, and the mass excised.

Case VII This case is presented because of unusual features. This child was born with a capillary skin nevus covering a fluctuating mass in the submaxillary region and somewhat lower She was treated with radium until, at the age of nineteen months, the skin was markedly atrophied as seen in Figure 472, *a* (p 698) Residual capillary hemangioma is apparent.

The visible and palpable respiratory fluctuation of the mass, immediately beneath the skin and in a line down the neck, suggested participation of the superficial venous circulation such as the external jugular

It has been aspirated numerous times through a period of years. Its proper management is the same as discussed in the preceding case (Fig. 469 p 695)

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The author's purpose is to discuss the clinical manifestations rather than the embryology of the lesion The interest is not in the blind tract with no secretion or an occasional drop of mucoid material but, rather in the inflamed, suppurating draining tract. It has been previously stated that the author knows of no safe satisfactory management of those fistulas which invade the parotid gland and present multiple small cysts and racemose tracts He has twice injected such tracts with methylene blue undertaken their surgical removal and abandoned the effort when it became evident that successful removal would involve the facial nerve.

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Both embryonal layers are present in the lining when the membranous septum has ruptured. The contents are usually sebaceous and may contain hair Those having a squamous-celled mucous membrane with a basal layer of columnar cells contain mucus.

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region for eight or nine years. The rounded borders blended into the soft tissue beneath the surrounding skin. The skin over the mass was unattached.

Procedure A transverse, elliptical incision was made over the center of the mass. The skin-muscle fascial layers were reflected upward and downward to the borders of the mass.

These were separated vertically and the stretched muscle fibers retracted. The tumor was incised and aspirated. This contained caseous material, some light brown fluid and hair It had a moderately thick, fibrous capsular wall

The capsule was dissected from the bordering tongue This terminated about two thirds of the distance to the foramen caecum.

The bordering tongue tissue and the muscular tissue were approximated with 00000 plain catgut and the skin flaps with 00000 Dermalon. A dressing was applied. See Figure 470

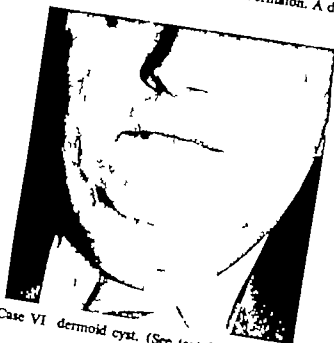


Fig. 470 Case VI dermoid cyst. (See text for detailed discussion.)

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These were separated vertically and the stretched muscle fibers retracted. The tumor was incised and aspirated. This contained caseous material, some light brown fluid and hair. It had a moderately thick, fibrous capsular wall.

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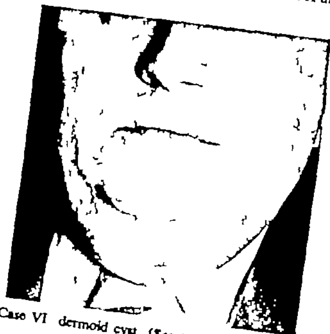


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The visible and palpable respiratory fluctuation of the mass, immediately beneath the skin and in a line down the neck, suggested participation of the superficial venous circulation, such as the external jugular

A parabolic incision was made beginning at the anterior superior margin of the involved skin and carried posteriorly and inferiorly to the clavicle. The angiomatous mass was elevated with the skin and platysma muscle. Two radicals entering the deep jugular and the external jugular were ligated. The latter was completely sclerosed in the mass. The inferior portion beyond the mass was the site of marked thinning and dilatation which was evident on each inspiration. There was a second dilated vein mesial to this running across the sternohyoid which increased in diameter about ⅜ inch (1 cm.) at each inspiration. This vein disappeared in the superior mediastinum



Fig. 471 Case VII hemangioma. (See p. 697 for detailed discussion.)



a b

Fig. 472 Case VIII capillary and cavernous hemangioma radiation skin atrophy (See text for detailed discussion.)

The skin over the anterior and right neck was elevated this was slid laterally and upward with traction, the mass and the maximum of involved skin allowing closure was excised and the approximating borders were closed with 00000 Dermalon.

The remaining atrophied skin (½ inch by 1¼ inches—13 by 3 cm.) was excised eight months later

The condition six years later is presented in Figure 472, *b* Revision of the stretched cervical scar is indicated. The pathologist reported that every microscopic field presented tumor formed by numerous capillary blood spaces separated by a highly cellular stroma. A few mitotic figures were found in several areas. There was no lymph node invasion. The tumor is locally malignant because of its invasive character

The deficiency in the vein wall beyond this tumor mass and the involvement of a second unrelated vein is another of frequent clinical evidences that the angioma does not always originate in the classical manner and that bordering capillaries and veins frequently have con

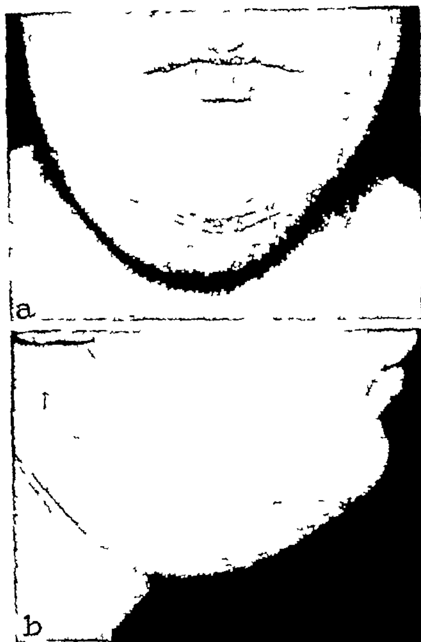


Fig. 473 Case IX lymphangioma simplex. (See p. 609 for detailed discussion.)

genital deficiencies which become evident under slight changes in tension and pressure

Lymphangioma

This is a tumor composed of lymph vessels and spaces. It arises from congenital developmental defects in the lymphatic system. Its structure

consists of endothelial cells and connective tissue which are concerned in its neoplastic behavior

It is a slow-growing single or multiple tumor of the skin connective tissue, areolar tissue and, possibly the underlying muscle It is classified as *simplex* when it consists only of an anastomosing network of vessels as *cavernosum* when there is a communicating system of closed lymph spaces filled with lymph or coagulum and *cystoid* when the mass consists of various-sized cysts.

This pathological condition may appear in different, unrelated and distant parts of the body The case presented has also a similar condition in one hand and wrist.

Case IX. Lymphangioma Simplex of the Right Submaxillary and Submental Areas; Facial Asymmetry This produces a marked cosmetic disability but creates no functional disturbance (Fig. 473 *a b* p 699)

Surgical correction consisted in a collar incision from the right sternomastoid muscle along the digastric muscle past the midline and a second incision from the mesial end of the first one to the submental border The skin and subcutaneous tissue were freely elevated traction was made on the flap upward and medially the excess was excised, and the edges were approximated with Dermalon This was supplemented by x radiation which has been of little value as independent treatment. This endothelium has little sensitivity

The patient presented a similar circumscribed lesion on the right parietal area and the left forearm and hand (see Fig. *551* p *801*)

Cystic Hygroma Colli

This cyst extends upward into the neck and downward under the clavicle from paired jugular sacs lateral to the jugular vein It has a fibrous wall containing lymphatic tissue and is lined by endothelial cells. The cells are radiosensitive early in life

The surgery of these cysts is unusually dangerous and perhaps impossible under some conditions. Our treatment is operation and x radiation.

The case presented in Figure 474 *a b* is that of an infant three weeks of age with a fluctuating tumor (*A* in Fig. 474 *b*) 8 inches (20 cm) in length by 3 inches (7.5 cm) in width with a cystic fold extending around the back of the neck to the right sternomastoid muscle

A large quantity of thin amber fluid was aspirated and the area exposed to x ray The result is cessation of secretion leaving large folds of excess skin which will ultimately be excised The appearance at the end of a year is presented in Figure 474 *c d*

Lipoma Annulare Colli

This is a diffuse form of lipomatosis of the skin subcutaneous and intramuscular tissues of the neck which may produce great enlarge

Fig. 474 Cystic hygroma colli. (See p. 700 for detailed discussion.)

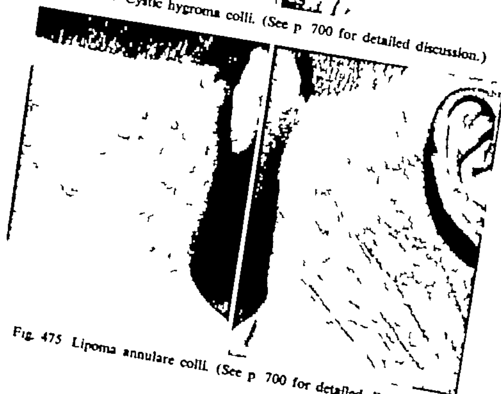


Fig. 475 Lipoma annulare colli. (See p. 700 for detailed discussion.)

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It is a slow-growing, single or multiple tumor of the skin connective tissue areolar tissue and possibly the underlying muscle It is classified as *simplex* when it consists only of an anastomosing network of vessels as *cavernosum* when there is a communicating system of closed lymph spaces filled with lymph or coagulum and *cystoid* when the mass consists of various-sized cysts

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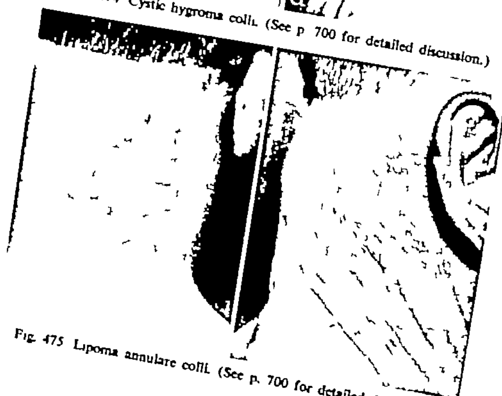


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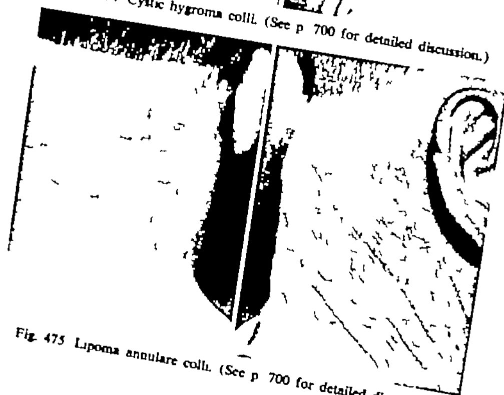


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The surgery of these cysts is unusually dangerous and perhaps impossible under some conditions Our treatment is operation and x-radiation

The case presented in Figure 474 *a b* is that of an infant three weeks of age with a fluctuating tumor (*A* in Fig 474 *b*) 8 inches (20 cm) in length by 3 inches (7 5 cm) in width with a cystic fold extending around the back of the neck to the right sternomastoid muscle

A large quantity of thin amber fluid was aspirated and the area exposed to x-ray The result is cessation of secretion leaving large folds of excess skin which will ultimately be excised The appearance at the end of a year is presented in Figure 474 *c d*

Lipoma Annulare Colli

This is a diffuse form of lipomatosis of the skin subcutaneous and intramuscular tissues of the neck which may produce great enlarge-

Fig. 474 Cystic hygroma colli. (See p. 700 for detailed discussion.)

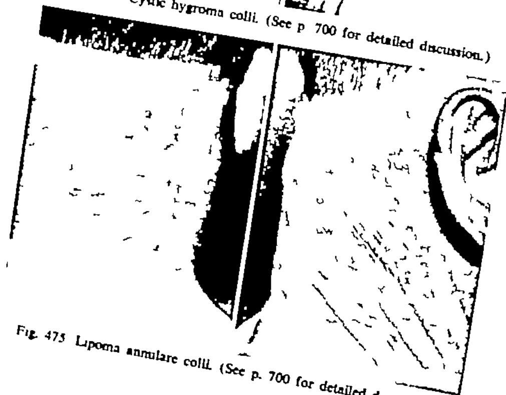


Fig. 475 Lipoma annulare colli. (See p. 700 for detailed discussion.)

consists of endothelial cells and connective tissue which are concerned in its neoplastic behavior

It is a slow growing single or multiple tumor of the skin connective tissue areolar tissue and possibly the underlying muscle It is classified as *simplex* when it consists only of an anastomosing network of vessels as *cavernosum* when there is a communicating system of closed lymph spaces filled with lymph or coagulum and *cystoid* when the mass consists of various-sized cysts

This pathological condition may appear in different, unrelated and distant parts of the body The case presented has also a similar condition in one hand and wrist.

Case IX. Lymphangioma Simplex of the Right Submaxillary and Submental Areas, Facial Asymmetry This produces a marked cosmetic disability but creates no functional disturbance (Fig 473 *a b* p 699)

Surgical correction consisted in a collar incision from the right sternomastoid muscle along the digastric muscle past the midline and a second incision from the mesial end of the first one to the submental border The skin and subcutaneous tissue were freely elevated traction was made on the flap upward and medially the excess was excised and the edges were approximated with Dermalon. This was supplemented by x radiation which has been of little value as independent treatment. This endothelium has little sensitivity

The patient presented a similar circumscribed lesion on the right parietal area and the left forearm and hand (see Fig 551 p 801)

Cystic Hygroma Colli

This cyst extends upward into the neck and downward under the clavicle from paired jugular sacs lateral to the jugular vein It has a fibrous wall containing lymphatic tissue and is lined by endothelial cells. The cells are radiosensitive early in life

The surgery of these cysts is unusually dangerous and perhaps impossible under some conditions. Our treatment is operation and x-radiation

The case presented in Figure 474 *a b* is that of an infant three weeks of age with a fluctuating tumor (*A* in Fig. 474 *b*) 8 inches (20 cm) in length by 3 inches (7 5 cm) in width with a cystic fold extending around the back of the neck to the right sternomastoid muscle

A large quantity of thin amber fluid was aspirated and the area exposed to x ray The result is cessation of secretion leaving large folds of excess skin which will ultimately be excised The appearance at the end of a year is presented in Figure 474 *c d*

Lipoma Annulare Colli

This is a diffuse form of lipomatosis of the skin subcutaneous and intramuscular tissues of the neck which may produce great enlarge-

incision of the same length, at an angle of approximately 90 degrees, was made to the right from the top of the first incisions, and a similar one to the left from their inferior end. The tumor mass was deeply excised. The flaps were widely elevated, transposed and sutured with 00000 Dermalon, as pictured in Figure 476, *b*. The area marked *A* is a necrosis of surface scar epithelium due to tension and so forth.

ment. It is not a true lipoma but a hypertrophy of the local fat tissue. It is obvious that surgery would be limited to the subcutaneous fat and of no permanent value (see Fig. 475)

MALIGNANCY

The destructive treatment of malignancy is the same here as in any other area of the body The plastic repair of the resultant defect must



Fig. 476. Case I Carcinoma in an old radiated burn scar *a* Necrosis of surface scar epithelium. (See text for detailed discussion)

use the same sound reconstructive procedures which have been previously discussed.

The purpose in presenting the following case is to indicate a long period—seventeen years—of poor management the result of which was a constant menace, and to describe the ease of its correction

Case I. The patient, aged twenty four had suffered an extensive burn from a gasoline explosion at the age of seven. The deepest destruction was on the back and sides of the neck. An area in the midline had failed to heal during these years in spite of several types of treatment.

The condition presented at the time of examination is seen in Figure 476 *a*. The granulating mass bordered by an elevated, indurated scar $^3/_{16}$ inch (4 mm.) in width is 1 inch (2.5 cm.) in diameter Dense scar extends from 1 inch (2 5 cm.) behind the left ear to a point 3 inches (7.5 cm.) behind the right ear and to a horizontal line around the neck which is at the level of the hyoid bone.

The skin below and lateral to this lower scar line has good circulation and is suitable for flaps to accomplish excision and repair The surface lymphatics were probably destroyed at the time of the burn. There were no palpable glands.

The mass was widely excised between two vertical elliptical incisions. A lateral

incision of the same length, at an angle of approximately 90 degrees, was made to the right from the top of the first incisions, and a similar one to the left from their inferior end. The tumor mass was deeply excised. The flaps were widely elevated, transposed and sutured with 00000 Dermalon, as pictured in Figure 476 *b*. The area marked *A* is a necrosis of surface scar epithelium due to tension and so forth.



Chapter XII

FACIAL BONES: FUNCTIONAL AND COSMETIC DISABILITY

Certain pathological conditions, either developmental or acquired of the bones of the face and forehead produce distressing functional and cosmetic disabilities with consequent psychic changes which demand the best judgment, planning and technical performance of the surgeon

The developmental conditions are congenital or are acquired as the result of surgery which interferes with blood supply or treatment such as x radiation or radium exposure of some type, in early childhood which retards or inhibits function of the growth centers (see Fig. 239 p 355)

Examples of ordinary types are common among the clientele of this special type of practice. Some of the more unusual types of congenital developmental abnormalities are presented to emphasize in most instances the value of procedures previously discussed for use in analogous conditions

ASYMMETRY

Oxycephalus; Dysostosis

There are numerous synonyms for this condition The purpose in presenting this anomaly is not to discuss the cranial and consequent intracranial disabilities but to indicate its relation to accompanying developmental abnormalities of the orbit nose facial bones and so forth producing cosmetic and functional disabilities which to a degree become the responsibility of the reconstructive surgeon

The skull develops from so-called flat bones with two cortical layers

and included diploe The skull base and face skeleton are originally cartilaginous and the vault is membranaceous Several points of ossification appear later for each segment of the skull face, and so on. Their growth leaves narrow spaces—the sutures—beyond these growth changes All basal suture lines except the sphenopalatine ossify during the first years following birth. Those of the vault do not disappear for years

Dysostosis results from premature union of skull sutures and mal formation of the head and face bones characterized by an adenoid facial expression proptosis and a bulging forehead There may be also an oxycephalus, a tower-shaped skull peaked at its vertex. At times this is accompanied by other malformations The condition is uncommon In more than one member of a generation or successive generations. It is usually apparent at birth is more frequent in the male and is exaggerated as the brain grows. The orbital openings are wide the orbits are shallow and the socket is high and vertical. The optic foramina are usually normal, but in some cases, are markedly narrowed The protrusion varies and may be unequal on the two sides. The lid apertures slant outward and downward Vision is usually defective. Ability of the adult to read is rare owing to intracranial pressure The nose is narrowed and prominent and has septal deformities The maxillae are hypoplastic, the palate is high-arched, there is dental malocclusion the mandible is normal, and the sinuses are small or absent.

Mentality of the youth and adult is usually normal There may be associated malformation such as syndactylism and the like more common in the upper extremity

Treatment of the cranial condition is of little value Decompression accomplished early may be of some benefit, but the later production of artificial sutures and so forth seems unsound

Case I. This patient, aged thirty-eight had a typical oxycephalus and other results of dysostosis. There was marked facial asymmetry nasal deformity and proptosis. Both the father and grandfather had a similar proptosis. There was a vertical tower-head type of frontal which placed the upper orbital margin considerably anterior to the inferior margin, and the nasal bones projected at an angle of 40 degrees and articulated with normal nasal processes. There was marked septal deformity with nasal occlusion. The entire nose deviated to the left (Fig. 477 *a b c* p. 706) The vomer presented in the center of a high-arched palate about 1 inch (2.5 cm.) above the occlusal surface of the teeth.

The sinuses were normal

Note the marked facial asymmetry in Figure 477 *a*

X ray Study of the Skull The bones of the skull were thin. In the frontal and parietal bones were lacunae or convolution depressions varying in size from 1 to 4 or 5 cm. in diameter The frontal bone, instead of describing a gentle curve from its posterior portion anteriorly and downward, extended almost directly forward with perhaps a slight inclination upward to about the level of the posterior margin of the right orbit, and then swung acutely downward to its junction with the nose. The angle thus formed by the curvature of the frontal bone was much more acute than is normally seen. The floor of the anterior fossa was short, accounting for the shallow orbits. The middle fossa was large and deep as compared to the anterior and posterior fossae The posterior fossa was relatively short and shallow in its anteroposterior direction.

No suture lines were made out in the skull in any of the films. There was an asymmetry of the skull, the left side being considerably larger than the right. There was also an asymmetry of the face. As nearly as could be determined from these films, the left side was larger than the right.

Mainly the frontal and parietal bones were involved, and cranial sutures were absent. The plane of the left orbit was so situated that the superior portion of the



Fig. 477 Case L *a b* and *c* Oxycephalus, facial asymmetry nasal deformity and proptosis *d* and *e* the nasal condition after internal and external correction (See p. 705 for detailed discussion.)

orbit was much farther anterior than the inferior portion of this orbit. The craniofacial angle was only 70 degrees, whereas normally the craniofacial angle is about 90 degrees.

Craniofacial Dysostosis with Stenosis of the Sutures of the Skull and Associated Facial Deformity and Shallowness of the Orbits (see p. 704) The external nasal condition was corrected for obvious cosmetic improvement and the septum reconstructed to permit nasal function (see pp. 560 and 577)

The patient has a keen mentality normal vision and body It is apparent that there should be no interference with the other anomalies.

Frontal Anomaly

Case II. The development anomaly of this frontal (Case II) consists of a normal left half a deep groove down the median fissure a high boss over the supra-orbital area and a marked depression over the temporal area. This is a so-called flat membranous bone with two cortical layers and included diploe The probable development is two thin cortical layers and no diploe The author has reconstructed one case in which there was only a thin deep cortical plate with dehiscences exposing dura.

There is an anomaly of the right maxillary nasal process and facial asymmetry (Fig. 478)



Fig. 478 Case II anomaly of the frontal and right maxillary nasal process facial asymmetry

Reconstruction with dermal implants without visible scar is readily accomplished The scalp is incised above the hair line and elevated from the periosteum by blunt dissection and the implant is drawn in desired position by traction sutures which are tied and retained as fixation for two days (see Fig. 227)

Median Frontal and Nasal Cleft

Case III This case presents a median cleft or groove of the lower half on the frontal bone similar to Case II cleft of the lower half of the nose anomaly of the nasal process of the right maxilla and triangular cartilage and marked facial asymmetry (Fig. 479 *a b c*)

The reconstruction of the frontal groove is accomplished with a dermal inlay drawn in by traction sutures through the intranasal incision for the required rhinoplasty after its completion (see p 135)







Fig. 479 Case III: median frontal and nasal cleft anomaly of the right nasal process and upper lateral cartilage facial asymmetry *a* and *b* The original condition *c* the result of procedure. (See p 707 for detailed discussion.)

The rhinoplasty consists in lowering the dorsal ridge reconstruction of the right lower lateral cartilage and implantation of plates of the excised quadrilateral cartilage to obtain the required contour of the right

upper half of the nose This may be well accomplished with a dermal graft, but not with the certainty and permanence of the available cartilage (see Rhinoplasty p 560)

Hemidystrophy

This localized atrophic disability is generally developmental and is frequently accompanied by other anomalies It may also be acquired



Fig. 480. Case IV hemidystrophy: mental cleft facial asymmetry anomaly of the right malar bone. *a* and *b* The original condition *c* the result of fat fascial implant.

from trauma or local pathological states It results from failure of development of the cranial center or particular branches of the trophic nerve supply of the involved part. There is no disturbance of sensory or motor function The disability is entirely cosmetic

Case IV The patient presented here was a girl, aged thirteen, with a marked facial asymmetry a median cleft of the chin, a deviated nose, right facial dystrophy and anomaly of the right malar bone (Fig. 480 *a*, *b*)

The facial contour was restored with a fat-fascial implant prepared on the thigh some fifteen years before this date. It is not the author's choice of procedure subsequently. Dermal implants (see p. 135) are more readily prepared, more exactly applied, enjoy more certainty of behavior and are easily supplemented, if required, after a period of years.

A longitudinal incision over the fascia lata was made on the thigh, the desired width of flap with its fat attached was incised to sufficient length to permit folding with the fat included within the fascia, and the approximating fascial edges were fixed with several 00000 plain catgut sutures.

An incision of the facial skin was made about the ear as in meloplasties (see p. 345) and the skin of the entire defective area elevated. The facial vessels, parotid duct and median branch of the seventh nerve were clearly exposed by this skin elevation. The facial pad was drawn into position with traction sutures and the face incision approximated in the usual manner.

The median chin cleft was repaired by the Poulard method (see p. 21?).

The result of these procedures several months later is presented in Figure 480 c.

Congenital Malformation of the Mandible

Case V. This patient was first examined at the age of three with the following history. The obstetrician who delivered the child told the parents that he had a "high arched palate and an underslung jaw and that there was nothing to worry about." A medical attendant for chickenpox at the age of eight months discovered a cleft of the palate, ear maldevelopment, and so forth, in addition to the maldevelopment of the mandible, and transferred the child to an oral clinic. The advice here was exercise of the lower jaw with an appliance on the nursing bottle to stimulate forward mandibular movement, also tongue exercises (Fig. 481 *a, b, c*, p. 711).

The child was forced to sleep in a sitting position and had great difficulty in swallowing liquids of any type.

Examination by palpation, measurement, dental impression and construction of a model revealed the mandible seen in Figure 481 *d, e*. This was confirmed in the x-ray studies.

The tip of a small tongue projected superiorly to the location of the uvula. There was practically no ability to project the tongue anteriorly. This permitted the child to convert laryngeal sounds into noises, but absolutely prohibited any speech. The lower margin of the mandible contacted the hyoid with a consequent short, undeveloped mylohyoid and so on which permitted the base of the tongue practically to fill the hypopharynx and cover the larynx and other structures.

There was very slight forced movement of the mandible. Respiration in the recumbent position was impossible.

High tracheotomy was performed and the child generally prepared for surgery during a period of three weeks.

It was planned to resect the long ascending rami across or above the mandibular foramen, free these vessels and nerves, and draw the horizontal part into dental occlusion with elastic traction over a period of days. The bone defects were to be grafted.

Procedure. STAGE 1. RESECTION OF MANDIBLE. A curvilinear incision was made along the lower margin of the left mandible, the soft tissues were reflected, and a diagonal, transverse section was removed from the buccal cortex to expose the vessels and nerve. These were isolated and the resection was completed. It was found that the horizontal ramus and right jaw permitted moderate movement and that the left ascending ramus was fixed. Further investigation revealed that the coronoid process, zygoma and temporomandibular joint were entirely fused. The patient's condition terminated this procedure.

An interval of twelve days elapsed.

STAGE 2. RESECTION OF RIGHT RAMUS. The same procedure as in the first stage was repeated.

An interval of three days elapsed.

STAGE 3 CIRCUMFERENTIAL WIRE AND ELASTIC TRACTION. A plaster head cap containing stiff coat hanger wire was applied on the previous day Stainless steel

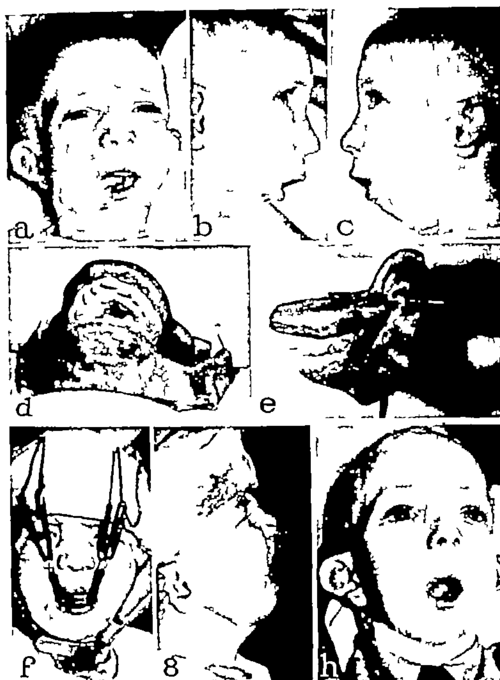


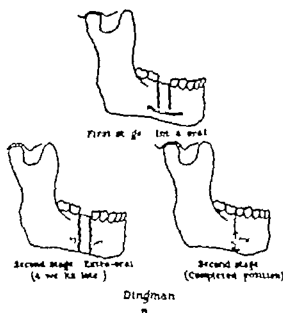
Fig. 481 Case V congenital malformation of the mandible. *A b* and *c* The original condition, *d* and *e* models of the jaws and occlusion *f* and *g* elastic traction on circumferential wires after resection of both rami *g* and *h* the result of the traction. (See p. 710 for detailed discussion.)

wire was passed around the mandible mesial to each mental foramen (see Fig. 68 p 94) and attached to the cap wires with rubber bands (Fig. 481 *f g*)

An interval of two months elapsed.

STAGE 4 REPLACEMENT OF TRACTION The plaster cap and circumferential wires

edentulous areas in either the premolar or molar areas The desired area is that of the first molar



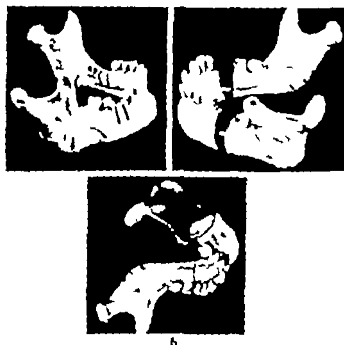


Fig. 483 Dingman's procedure. (See p. 713 for detailed discussion.)

The size of the bone to be removed on each side will not vary more than a few millimeters in most cases. The width and shape of this section are accurately predetermined on the plaster casts by the degree of opening and closing of the bite to obtain normal occlusion as well as by the degree of projection of the jaw

Lateral deviation or cross bite is corrected by a wider section on the side opposite to the deviation. The surgeon should consult the orthodontist before final determination of procedure



Fig. 484 Case VI prognathism. *a* and *b* The original condition *c* and *d* the result of the procedure. (See p. 713 for detailed discussion.)

STAGE 1 The first stage of surgery may be done at the time of dental extraction, which should be accomplished without loss of lingual or

buccal plates and with a minimum of trauma. In edentulous cases the incision is made along the alveolar margin and along the gingival border of the adjacent teeth The mucoperiosteum is elevated from this area on both sides. The bone is cut transversely and downward with a bone drill. The cut terminates at a safe distance above the nerve The width of the cuts is exactly as previously determined on the casts

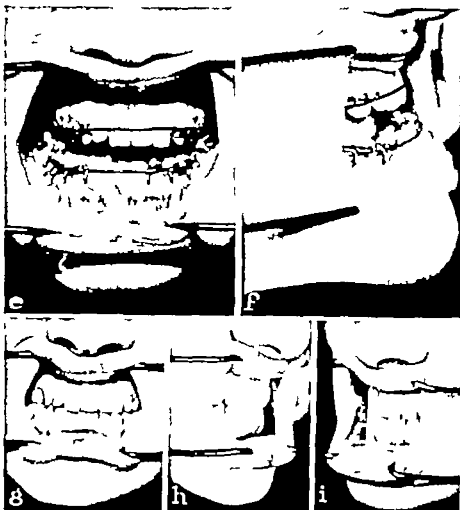


Fig. 484 (continued) Dental occlusion. *e* and *f* The original occlusion and orthodontic preparation for fixation and elastic traction *g* *h* and *i* the corrected occlusion.

The two cuts on the buccal cortical plate are carried well down but not into medullary bone below the roots of the teeth This aids in easy identification in Stage 2 No bone is removed The soft tissues are sutured over the ridge These sutures are removed on the third or fourth day

The orthodontist constructs accurate sturdy upper and lower appli

ances, attached to the teeth by cemented bands during this healing period A satisfactory one permits intermaxillary rubber band fixation and horizontal fixation of the approximated bone by hooks on the adjacent teeth (Fig. 484 *e f*) Simple occlusal splints of acrylic are provided in cases where teeth in the lower arch will not contact those in the upper arch.

An interval of six weeks elapses Local anesthesia, when expedient.

STAGE 2 The skin incision is marked upon the skin to avoid confusion after draping. Incise ⅜ inch (1 cm) below and parallel to the inferior border of the mandible over the selected area. Avoid the mandibular branch of the seventh nerve. Expose the lower bone border Separate the periosteum laterally and medially until the cuts of Stage 1 are visible. Extend the cuts through the cortical bone down to the border of the mandible. Make a horizontal bone cut ⅜ inch (1 cm.) above the border Insert and twist a chisel to fracture loose this plate and expose the nerve. Remove the surrounding medullary bone. Drill holes through each bone end just above the lower border for the approximation wires Hollow out the medullary bone around the nerve to provide a pocket for it and the vessels when the bone ends are approximated Clear residual bone from the nerve and remove the entire block of bone above without perforating the oral cavity This is simple because the bone is unhealed after Stage 1

Approximate the bone tightly with 25 gauge steel wire Suture the soft tissue in layers, and dress Place the rubber bands on the splint. Remove these traction bands in two weeks and replace with fine stainless steel wire. This fixation is deferred in cases with general anesthesia until recovery is complete Some type of fixation—bands or wire—is maintained for eight weeks

Retrusion of the Mandible with Malocclusion

The retrusions with good dental occlusion are well corrected cosmetically with bone and/or cartilage mental grafts These may be supplemented with dermal graft when indicated

Those cases with marked malocclusion demand surgical advancement in the mandible for accomplishment of the desired cosmetic correction A combination of these two types of reconstruction may occasionally be essential Osteotomy of the ascending ramus has the same objections as stated under the discussion of prognathism Dingman has applied the principles of his two stage procedure to a technic for this correction. This improves the occlusal relations and the contour of the chin.

The alveolar nerve and its associated structures are not damaged There is no interference with the muscles of mastication A single vertical cut is made bilaterally down to the apices of the teeth in Stage 1 The soft parts are approximated and a healing interval of three weeks is allowed as in the previous discussion The appliances are made by the orthodontist

buccal plates and with a minimum of trauma. In edentulous cases the incision is made along the alveolar margin and along the gingival border of the adjacent teeth The mucoperiosteum is elevated from this area on both sides. The bone is cut transversely and downward with a bone drill. The cut terminates at a safe distance above the nerve The width of the cuts is exactly as previously determined on the casts

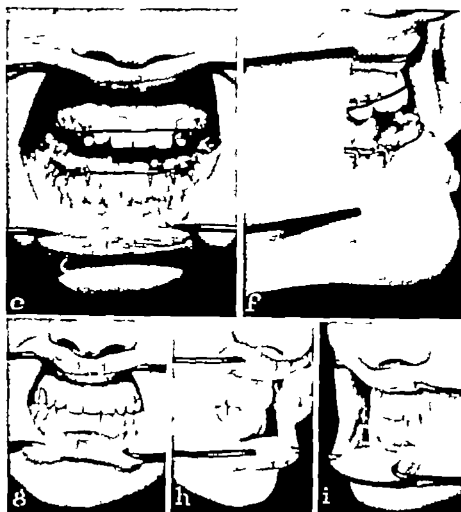


Fig. 484 (continued) Dental occlusion. *e* and *f* The original occlusion and orthodontic preparation for fixation and elastic traction *g* *h* and *i*, the corrected occlusion.

The two cuts on the buccal cortical plate are carried well down, but not into medullary bone below the roots of the teeth This aids in easy identification in Stage 2 No bone is removed. The soft tissues are sutured over the ridge. These sutures are removed on the third or fourth day

The orthodontist constructs accurate sturdy upper and lower appli

ances, attached to the teeth by cemented bands, during this healing period A satisfactory one permits intermaxillary rubber band fixation and horizontal fixation of the approximated bone by hooks on the ad jacent teeth (Fig. 484 *e f*) Simple occlusal splints of acrylic are provided in cases where teeth in the lower arch will not contact those in the upper arch.

An interval of six weeks elapses. Local anesthesia, when expedient.

STAGE 2 The skin incision is marked upon the skin to avoid con fusion after draping. Incise ⅜ inch (1 cm.) below and parallel to the inferior border of the mandible over the selected area. Avoid the man dibular branch of the seventh nerve Expose the lower bone border Separate the periosteum laterally and medially until the cuts of Stage 1 are visible. Extend the cuts through the cortical bone down to the border of the mandible Make a horizontal bone cut ⅜ inch (1 cm.) above the border Insert and twist a chisel to fracture loose this plate and expose the nerve Remove the surrounding medullary bone Drill holes through each bone end just above the lower border for the approximation wires Hollow out the medullary bone around the nerve to provide a pocket for it and the vessels when the bone ends are approximated. Clear re sidual bone from the nerve and remove the entire block of bone above without perforating the oral cavity This is simple because the bone is unhealed after Stage 1

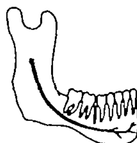
Approximate the bone tightly with 25 gauge steel wire. Suture the soft tissue in layers, and dress. Place the rubber bands on the splint Remove these traction bands in two weeks and replace with fine stain less steel wire. This fixation is deferred in cases with general anesthesia until recovery is complete Some type of fixation—bands or wire—is maintained for eight weeks.

Retrusion of the Mandible with Malocclusion

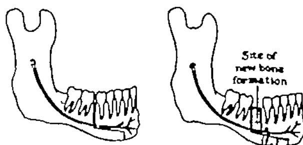
The retrusions with good dental occlusion are well corrected cosmetically with bone and/or cartilage mental grafts. These may be supplemented with dermal graft when indicated

Those cases with marked malocclusion demand surgical advancement in the mandible for accomplishment of the desired cosmetic correction. A combination of these two types of reconstruction may occasionally be essential. Osteotomy of the ascending ramus has the same objections as stated under the discussion of prognathism. Dingman has applied the principles of his two stage procedure to a technic for this correction This improves the occlusal relations and the contour of the chin

The alveolar nerve and its associated structures are not damaged. There is no interference with the muscles of mastication A single verti cal cut is made bilaterally down to the apices of the teeth in Stage 1 The soft parts are approximated, and a healing interval of three weeks is allowed as in the previous discussion The appliances are made by the orthodontist



F rst Stage



Second Stage

Fig. 485 Dingman's procedure for retrusion.

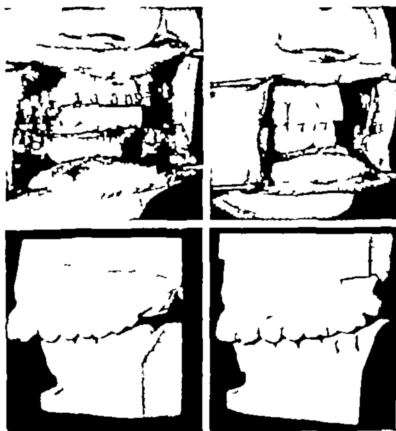


Fig. 486. Original dental occlusion. *Left* Before and, *right* after

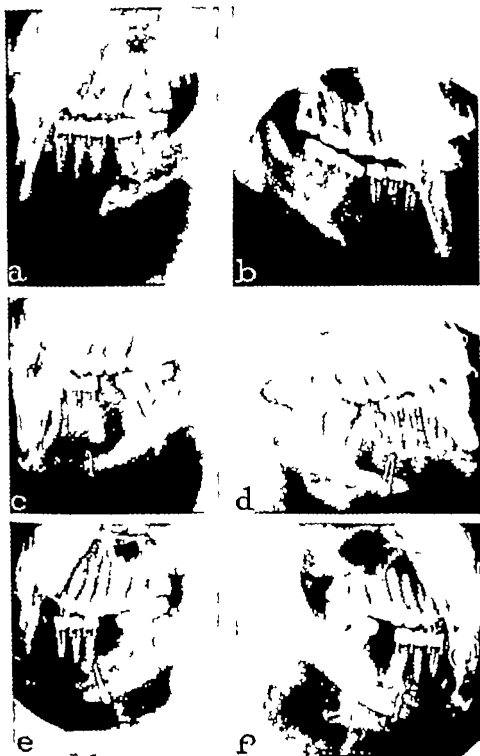


Fig. 487 X-ray of the procedure. *a* The original condition *b* Stage 1 initial cut in the mandible *c* and *d* Stage 2, second mandibular incision, advancement and wiring; *e* and *f* result of the procedure.

In the second stage the inferior border of the mandible is exposed, the first bone cut located, the mucoperiosteum elevated widely and a vertical cut is made at least 1 inch (2.5 cm.) anterior to the former one with a $\frac{5}{16}$ inch (8 mm) steel circular saw on a dental mandril from the inferior border to a level below the nerve. Then a horizontal cut is made from the top of this vertical cut posteriorly below the nerve to the line of the original cut. A small bone drill is used to cut the lateral and mesial cortical plates from the bottom of the original vertical cut to this horizontal one A small osteotome inserted in the horizontal cut fractures out the included cortical bone plates. The medullary bone surrounding the nerve is fractured The anterior segment is advanced to the desired position and a drill hole made through the anterior segment above the nerve. A steel wire threaded through this is passed around the lower border of the posterior segment and fastened through a drill hole anterior to this contact. The wire is twisted tightly Suture the soft tissue in layers. Apply the elastic traction bands and dress.

The patient presented in Figure 486 was operated on on my service, by Dr Dingman while he was an associate on my staff I am indebted to him for personal communications giving me technical detail and some of the illustrations of procedure.

Case VI. This patient, aged twenty-three, presented a mandibular prognathism of $\frac{3}{8}$ inch (1 cm.) The second mandibular molars were in contact with the first maxillary ones.

Procedure. STAGE 1 Both mandibular first molars were extracted without trauma and the orthodontic appliances constructed.

An interval of three weeks elapsed.

STAGE 2. INTRA-ORAL BONE INCISIONS. Two vertical transverse cuts were made through the alveolus to within 2 or 3 mm. of the nerve, as described above (see Figs. 483 and 484 *a, b*)

An interval of three weeks elapsed.

STAGE 3 EXTERNAL RESECTION See preceding discussion for the technical procedure (Fig. 484 *a, b*)

OSTEOMYELITIS

Loss of Right Mandible

Case I. This patient, aged twenty four had osteomyelitis at the age of five with loss of the right mandible from the cuspid tooth to the neck of the condyle. The area had been drained and sequestra removed through a submaxillary incision. This loss and unopposed mesial muscle traction on the left side produced marked facial asymmetry and malocclusion. Note particularly the position of the chin and cheek in Figure 488, *b* (p. 721)

The mandible loss was replaced with a rib graft and the occlusion obtained and maintained for many months with *a sliding occlusal splint* and an added prosthetic denture on the right side.

Procedure: STAGE 1 RIB GRAFT TO RIGHT MANDIBLE. An incision was made $\frac{5}{8}$ inch (1.5 cm.) below the residual right mandible and parallel to its lower border in the submaxillary area to elevate the skin and muscle and prepare a bed for the graft.

The bed for the ascending ramus was separated bluntly to the glenoid fossa. This

presented a moderate residual concavity to house the end of the graft. The end of the cartilage ramus was rounded to seat it in this concavity

The buccal cortical plate of the body of the mandible was sawed on a bevel to its center on a line ⅓ inch (8 mm.) long. This section of bone was split off with a chisel to form a fresh bed upon which the similarly prepared bone end of the rib could be lapped and wired.



Fig. 488 Case I osteomyelitis loss of the right mandible. *a* and *b* The original condition *c* result of mandibular reconstruction *d* final result following dermal inlay in the right cheek. (See p 720 for detailed discussion.)

The sixth left rib offered the right curve at its costochondral junction to reproduce the normal angle of the mandible. It was resected with a proper bone length and at its sternal junction. It was prepared as noted above, inserted in its bed, and drilled and wired with silver wire (Fig. 489 *a*, p 722)

The soft tissue of both chest and neck were approximated in layers with 00000 plain catgut and 00000 Dermalon.

A prepared retaining splint was cemented to the teeth on the left side, and the teeth were approximated with rubber band traction (Fig. 489 *a*)

An interval of nine months elapsed.

STAGE 2. DERMAL GRAFT IN DEPRESSION OF CHEEK. A marked depression 1½ inches (3.8 cm.) in diameter and ⅜ inch (1 cm.) deep presented at the angle of the jaw graft. This was in the area of scar marking the drainage incision for the original osteomyelitis. This scar line was incised, the skin and fascia covering the depression were elevated, and a double layer of dermal graft was implanted (see p. 135). This skin was taken from the abdomen, its epithelial surface shaved and scraped, and the edges of the two layers were approximated with several 00000 plain catgut sutures. The soft tissues were approximated in the usual manner and a moderate pressure dressing was applied.

An interval of seven years elapsed.

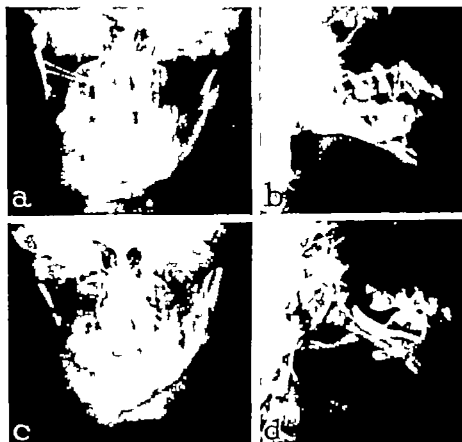


Fig. 489 Case I x-ray of the procedure. *a* and *b* The original loss and occlusion. The wire shadow in *a* is a hairpin. *c* and *d* Rib graft (right) elastic traction and fixation cap splints (left)

STAGE 3 CREATION OF A BUCCAL SULCUS. The patient had discarded the partial denture during this period following reconstruction of the jaw Impressions were made and cast models mounted on an articulator to determine the desired denture to provide proper occlusion.

The mucosa was incised along the buccal surface from the angle on the right side to the remaining sulcus anterior to the bone junction of the graft. The tissue was separated to an excess depth and width to allow for contraction, modeling compound was added to the buccal apron of the denture to permit it to fill this cavity and split skin was applied to line the cavity and covered with Furacin gauze, and the denture inserted. A Barton bandage was applied to immobilize the jaw

The result of these procedures nine years after surgery is presented in Figure 488 *d*

Mental Mandibular Loss

Case II This patient, aged twenty-six, had osteomyelitis as a child with loss of the mental part of the mandible between the two mental foramina. The residual ends of the rami were approximated in the midline by the muscle contraction and permitted to heal in this position.



Fig. 490. Case II osteomyelitis, mental mandibular loss. *a* and *b* The original condition, *c* and *d*, the final result after ilial bone graft and a cartilage mental onlay (See text for detailed discussion.)

Correction was attempted elsewhere after several years. It consisted in a submental incision bone exposure with section of the displaced ends, spreading of the two halves to approximate occlusion, and the introduction of a bone graft from the left ilium to maintain this position. This failed the graft was lost, and the ends of the rami overlapped the midline and healed with a large callus beneath the tongue.

She had, at the time of this examination some years after the surgery a marked retrusion of the chin to about the vertical plane of the hyoid bone The soft tissues are firmly adherent to the bone callus (Fig. 490 *b*)

The articular function was apparently normal—at least without symptoms of the long displacement.

It was decided to leave the edentulous mandible undisturbed and to restore its normal contour with an onlay bone graft of the desired shape. This would ultimately permit dental restoration with a prosthesis and approximately perfect facial contour

Procedure: STAGE 1 ILIAL ONLAY BONE GRAFT A curvilinear incision to include the former scar was made submentally along the lower border of the mandible. This extended from the bicuspid area of one side to the other The soft tissues were freely elevated to expose the width of the buccal plate, the periosteum was elevated from about 1 inch (2.5 cm.) of the areas about and anterior to both second bicuspids, and these bone areas were freshened with a chisel and burr

Bone of desired width was taken from the full length of the crest of the right ilium. Multiple V cuts were made from the cancellous surface into the cortical plate to permit bending, and the graft was fixed to the two prepared surfaces on the mandible with steel wire. The muscle and fascia were approximated with 00000 plain catgut and the skin with 00000 Dermalon. Several layers of plain gauze and a mold of dental modeling compound (Stent) to maintain desired shape and position were applied. Fluffed gauze and a Barton bandage completed the dressing.

The Barton bandage was maintained for a month. There was good bone union without incident.

An interval of four months elapsed.

STAGE 2. CREATION OF A BUCCAL SULCUS. The line of the existing buccal sulcus was incised around the external surface of the entire graft and separated to the desired depth. Modeling compound was molded in this cavity covered with split skin (0 016) raw surface externally and sutured in the cavity (see p. 21)

The contraction in this sulcus necessitated enlargement two months later

An interval of eight months elapsed.

STAGE 3 CARTILAGE GRAFT The protrusion of the chin on the grafted jaw was not entirely adequate.

The former submental incision was opened and the soft tissues were elevated. The wires were removed from the bone graft. A piece of costal cartilage 3 inches by ⅜ inch (7.5 by 1 cm.) was removed from the sixth rib carved and implanted. The soft tissue was approximated and the chin dressed with a mold as in Stage 1

An interval of three months elapsed.

STAGE 4 REVISION OF CARTILAGE. The cartilage was trimmed on its lateral ends to improve contour

The result of these procedures three years later is presented in Figure 490, *c d*.

A cosmetic rhinoplasty to shorten the dorsal ridge and produce a curved glabellar frontal attachment was performed later The author has no photograph to present this final cosmetic improvement.

TUMORS OF THE FACIAL BONES

The common types of tumor involving bones of the face and/or the adjacent soft tissues have been discussed previously It is the author's desire to present here some examples of less common types which involve or are attached to bone and may invade the adjacent soft tissues to produce marked functional and cosmetic disabilities

Benign Giant Cell Tumor

CASE I. There are immediate and subsequent features of this case that suggest developmental anomalies. Enlargement of the entire lower jaw was noticed at the age of two The presence of a well-formed tooth in thin border walls of each antrum and the proptosis of both eyes resulting from foreshortening of both orbital cavities permitted this consideration, and a long, subsequent history in relation to the orbits seems to confirm it.

A recent case of dysostosis with a similar proptosis permits careful x ray measurements which establish such an etiology (see p 705)

The patient was fifteen years of age at the time of this examination. Swelling of the entire lower jaw was noticed at the age of two years and had slowly progressed since. During this period the maxillae on both sides had been enlarging, particularly in the infra-orbital areas. There was a marked proptosis with disturbance of close vision. It was not possible to establish definitely that this was congenital, but it was noticed at the age when lower jaw changes were observed (Fig. 491 *a b* p. 726)

The mental area of the mandible measured 3½ inches (8 75 cm.) anteroposteriorly and 3 inches (7.5 cm.) superiorly-inferiorly

X-ray showed complete bone absorption, except thin cortical plates, from condyle to condyle. There was marked density of both antrums and tooth crowns in the thin border walls.

Procedure STAGE 1 PARTIAL EXCISION OF THE MANDIBLE TUMOR. The lip was incised from the vermilion border down the midline to the lower border of the mandible. The bottom of the buccal sulcus was incised from angle to angle. The soft tissue and the periosteum were reflected from a thin cortex, which the tumor perforated in several places.

The buccal cortex and gross tumor mass were excised from the horizontal ramus forward on both sides. This was a granulating, medullary type of mass with excessive bleeding.

The surgery was concluded because of the patient s condition.

The operated areas were packed with gauze and temporary sutures placed.

An interval of three days elapsed.

STAGE 2. EXCISION COMPLETED. The remaining anterior buccal cortex and tumor were removed. All lingual cortex firmly attached to the periosteum was retained.

The anterior borders of the ascending rami were excised and the tumor was removed.

Operated areas were packed with gauze saturated with potassium permanganate. The sulcus incisions were approximated and sutured. The lip was sutured temporarily Gauze dressing and a Barton bandage were applied The patient was fed by nasal tube for several days.

An interval of one month elapsed.

STAGE 3 BILATERAL RADICAL ANTRUM A modified Denker incision was made through the mucosa and periosteum around the pyriform nasal border and over the canine fossa. The mucoperiosteum was elevated to the infra-orbital foramen. The bone was removed from the lower end of the pyriform opening, the mucoperiosteum separated from the lateral nasal wall from the attachment of the inferior turbinate to the floor and this bony wall removed to the back of the antrum. Sufficient bone was removed from the anterior maxillary wall up to the orbital floor to permit clear direct view of the antrum.

A large tooth with its crown in the canine fossa wall and a small double root in the tumor mass removed on the left side, and a single root tooth with its crown in the midportion of the lateral antral wall was removed on the right side.

The tumor was removed from the antrums and alveolar processes. The walls were scrubbed with a gauze sponge saturated with picric acid in acetone. The nasal mucoperiosteal flaps were incised beneath the turbinal attachments and folded over the cut bony floor into the antrum. A small rubber bag on a catheter running through the nostril was inflated in the antrum to approximate the flap and control bleeding.

The mucous membrane incisions were approximated with horsehair

A result of digital pressure on the lower lid is presented in Figure 491 *c* (p 726)

The finger tip passed readily to the back of the globe and against what seemed to be a hard mass.

An interval of one month elapsed.

STAGE 4 EXPLORATION OF RIGHT ORBIT An incision was made through the periosteum around the inferior orbital rim. The periosteum of the lateral floor and wall was elevated about ⅝ inch (1.5 cm.) at which point it bulged inward and forward It was evident that if this was an extension of the maxillary tumor it could not

be removed without destruction of the eye. The bone did not have the elasticity of the thin cortical covering elsewhere. The tissues were approximated and sutured.

The vision of the right eye was 6/60 of the left, 6/12 the pupillary reactions were normal, and the fundi negative except for papillitis.



Fig. 491 Case I benign giant cell tumor proptosis. *a* *b* and *c* The original condition *d* microphotograph of the tumor *e* and *f* the final result of the procedure. (See p 724 for detailed discussion.)

Six months after the surgery the bone regeneration was such that dentures were supplied. Two and a half years following the surgery the patient returned with a mass ½ inch (1 cm.) in diameter on the lingual plate of the midline of the mandible. It presented a thin bony wall The content had the same pathological state as the original tumor

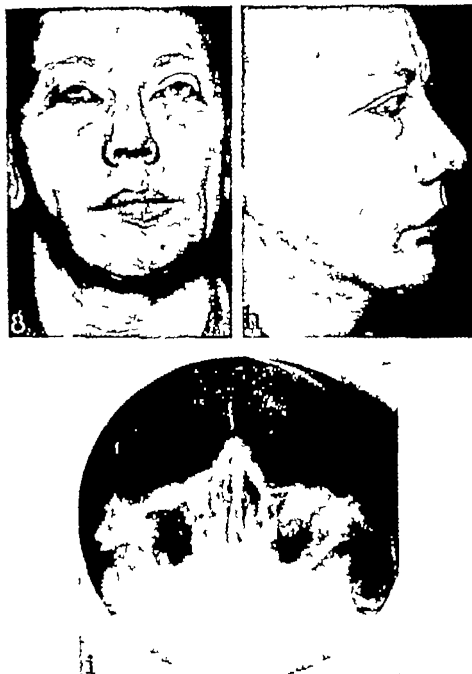


Fig. 491 (continued) *g* and *h* Appearance after 20 years *i* x ray picture after 20 years. (See p. 724 for detailed description.)

There has been no evidence of other recurrence or eye change during twenty years. The patient's present condition is presented in Figure 491 *e* *f*

Ameloblastoma; Adamantinoma

These are epithelial cystic tumors originating from remnants—"rests" —of the developmental period of enamel. They may consist, in early stages, of a largely solid mass but usually begin with multilocular cysts. The septa between the cysts may be either fibrous tissue or bone.

Pressure atrophies the cortical plates which bulge or perforate It is

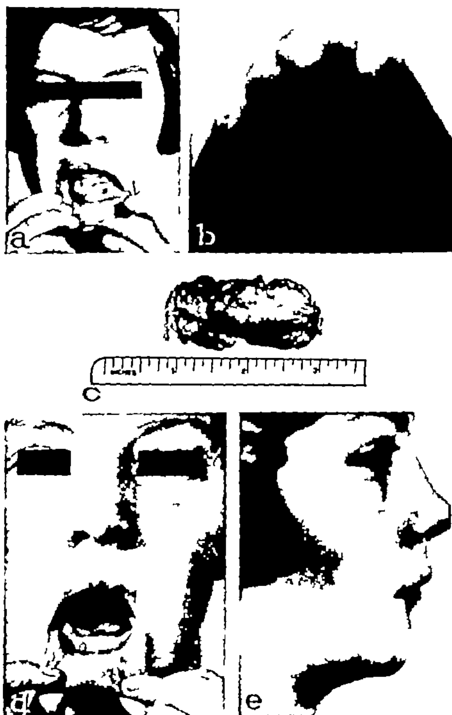


Fig. 492. Case II adamantinoma of the mandible. *a* The original condition *b* x ray of mental area of the mandible; *c* excised tumor; *d* healed mandible; *e* final result with denture (See p. 729 for detailed discussion.)

believed that they usually begin in the molar region of the mandible and grow slowly They are probably benign in most instances

Case II. Adamantinoma of the Mental Area. A girl, aged thirteen, had first noticed a growth in front of her lower central teeth one year ago. It increased in length and thickness greatly during this period. It now extended from one bicuspid tooth to the other The buccal plate was bulged and thin (Fig. 492, *a* p. 728) The x ray presented marked thinning of both the buccal and lingual cortex and several cystic cavities (Fig. 492, *b*)

Procedure A curvilinear incision beginning at the sulcus below the right second bicuspid was carried upward to the gingival line between the two bicuspids, and laterally along this line to the second bicuspid tooth in the left and down to the sulcus. The included mucoperiosteum was reflected downward. A similar flap was reflected on the lingual surface. The apparently involved bone was outlined with a chisel and the included tissue removed en masse (Fig. 492, *c*) This was 2 inches (5 cm.) long and ¾ inch (1.5 cm.) wide.

A strip of bone ¼ inch (7 mm.) wide remained along the lower border of the mandible. The mucoperiosteal flaps were approximated to bordering tissue and the remaining bone. An arch wire from second molar to second molar was wired to the teeth.

Pathological report Neoplasm characterized by expanding masses of tall columnar epithelium with tendency to liquefaction and cyst formation Supported by a loose fibroblastic stroma and collagenous substance surrounded by definite capsule. Adamantinoma.

The patient's condition twenty two years later is presented in Figure 492, *d e*

Case III. Adamantinoma (see Case II). This tumor apparently started in the classical molar area of the mandible. The patient, aged twenty-eight, stated that the condition had started fifteen years previous to this examination with a molar extraction and a piece of adherent bone The cavity did not heal and drained, periodically "a milky solution."

The cavity was curetted several times, the last time ten years ago. Enlargement had been gradual for several years and rapid in the last several weeks.

X-ray findings were loss of the entire ascending and about half of the horizontal ramus a large cyst in the posterior portion of the remaining ramus marked bone loss to the symphysis. There appear to be some thin bony septa enclosing large cavities above the normal level of the horizontal ramus. The lateral canine and bicuspid were the three residual teeth in this pathological process.

Procedure Interdental wires were placed on the teeth in the left jaw to stabilize the remaining jaw after surgery

The excision was accomplished intrabuccally

A Gigli saw was passed around the mandible posterior to the lateral incisor The mucoperiosteum was incised along the sulcus to the tumor border and the incision carried upward and posteriorly The buccal and lingual periosteum was separated over the entire mass after several aspirations of quantities of cyst content. Some of these cysts were separated by thin bony septa. There was no bone structure representing the ascending ramus. Cystic areas and tumor masses were removed See Figure 493 *d* for the residual condition six years after this surgery

The mucoperiosteum was approximated along the floor of the mouth with 0000 silk. A Penrose drain was placed in the gutter created by the excision and brought through a stab opening in the area of the canine tooth. The gutter was packed with petrolatum gauze dusted with sulfathiazole

Two weeks after surgery a splint carrying a sliding metal strip to maintain the left mandible in occlusion was cemented to the upper and lower teeth.

The patient reports five years after this procedure that he is comfortable and has no evidence of recurrence. His cosmetic condition is presented in Figure 493 *b*



Fig. 493 Case III adamantinoma of the mandible. *a*, The original condition, *b* the result *c* x ray showing loss of the ascending and one-half of the horizontal ramus *d* x ray 6 years later showing regeneration. (See p. 730 for detailed discussion.)

Mixed Cell Tumor of the Palate

Case IV The patient, aged 47 noted a small rounded mass near the center of the junction of the velum and hard palate many years before this examination. It had recently increased rapidly in size.

At this time a pseudofluctuant mass 1½ inches (3.8 cm.) in diameter and raised ½ inch (13 mm.) filled the entire width of the velum, elevated the mucosa of the hard palate to the incisors, and was fixed to its periosteum. It created a functional disability characterized by difficulty with solid food and speech disturbance

Procedure A curvilinear incision through the mucosa was made over the maximum convexity of the mass from the area of one tuberosity anteriorly to the other

The included flap was elevated from the capsule of the mass posteriorly The capsule had definite structure. It was separated from the mucosa and muscle by blunt dissection, and the mass was removed. There was no lateral pharyngeal involvement. Pathological report Mixed Salivary Tumor (Fig. 494)



Fig. 494 Mixed cell tumor of the palate. (See p. 730 for detailed discussion.)

TRAUMA—MULTIPLE FRACTURES

The disabilities, cosmetic and functional or both as well as satisfactory, generally accepted correction of fractures with or without soft tissue laceration, have been previously discussed in connection with single areas, such as the nose, malar compound, mandible and so forth The value of simple reductions open wiring, elastic traction splinting and so on in such cases has been indicated

This type of *fracture without laceration* is presented here to indicate and emphasize the cosmetic and functional disabilities and their desirable correction by a logical simple technic with slight permanent cosmetic disabilities.

Case I. The patient, aged nineteen, suffered multiple, comminuted fractures in a transportation accident. There was fracture of the left malar bone at the zygomatic, frontal temporal and maxillary sutures, extensive comminution of the inferior border of the malar and fragmentation of the entire left maxillary wall and complete, transverse bilateral fracture of the maxilla extending upward and backward through the pterygoid plate (Fig. 496 *a*, p. 733) There was fracture of the nasal septal cartilage and vomer extending along the floor posteriorly The maxilla was displaced downward the entire length of the nasal septum. There was extensive comminuted fracture of the nasal bones and processes (Figs. 495 *a*, *b* 496 *a*)

Procedure Upper and lower buccal arch wires were fixed to the teeth with 25 gauge stainless steel wire passed around the teeth and over the arch wire. These provided attachment for intermaxillary rubber band traction (Fig. 496 *b*)

An incision was made through the skin over the right upper lateral aspect of the orbital margin to expose and drill the lateral part of the zygoma. A wire was threaded through this hole and passed downward and backward to the region of the second molar. A second wire was threaded through the outer inferior margin of the orbit and passed down to the first bicuspid area. The left zygomatic frontal

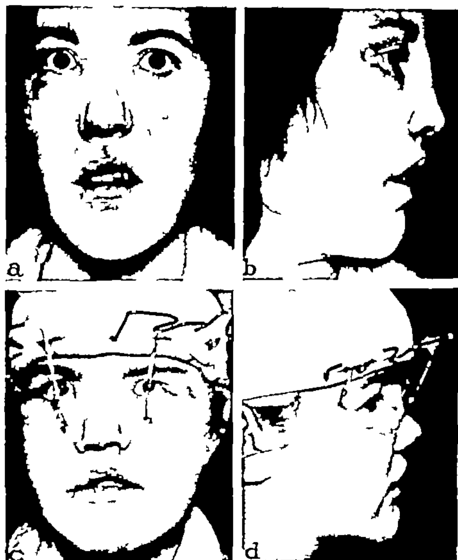


Fig. 495 Multiple fractures: transverse maxillary, zygomatic arch, nasal process and bones, and orbital rim. *a* and *b* The original condition. *c* and *d* elastic traction on the zygoma and maxilla. (See p. 731 for detailed discussion.)

suture was exposed and directly wired. An infra-orbital incision along the lower margin of the left orbit exposed multiple infra-orbital fractures and fracture of the nasal process, which was wired. A wire was passed through the orbital rim and out side through the incision for rubber band traction to prevent a tendency to posterior displacement. A similar wire was placed on the right side for rubber band traction. These traction wires hold the orbital margins forward and upward.

The nasal bone fractures were held in position with light packing and an external copper splint (see Fig. 89, p. 126). Rubber bands connecting the zygomatic wires to

the arch wire and the intramaxillary bands were placed immediately after reaction to the anesthetic.

The wires were removed at the end of six weeks. The result of these procedures is presented in Figure 496 *c d e*



Fig. 496 *a* Original occlusion *b* dental arch wires with elastic traction, *c* resulting occlusion, *d e* final result of the procedure. (See p. 731 for det… discussion.)

An incision was made through the skin over the right upper lateral aspect of the orbital margin to expose and drill the lateral part of the zygoma. A wire was threaded through this hole and passed downward and backward to the region of the second molar A second wire was threaded through the outer inferior margin of the orbit and passed down to the first bicuspid area The left zygomatic frontal

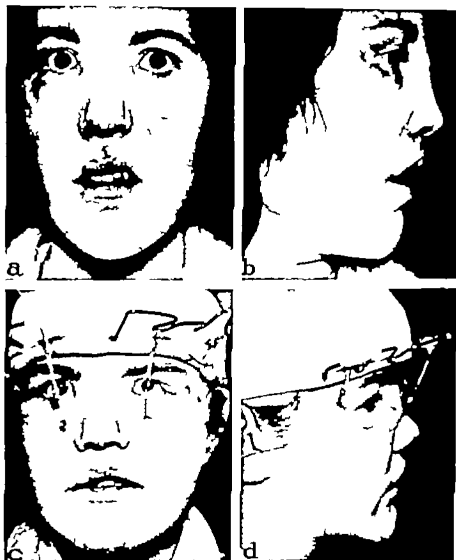


Fig. 495 Multiple fractures transverse maxillary zygomatic arch, nasal process and bones, and orbital rim. *a* and *b* The original condition *c* and *d* elastic traction on the zygoma and maxilla. (See p. 731 for detailed discussion.)

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Fig. 496 *a* Original occlusion *b* dental arch wires with elastic traction *c* resulting occlusion *d e* final result of the procedure. (See p. 731 for discussion.)

Chapter XIII

THE TRUNK

BURNS

The various lesions of the surface of the trunk both congenital and acquired require in general the same application of basic principles and plan of management as those presented in detail earlier in the text. Several examples are presented here for the sake of emphasis of desirable requirements

Corrective reconstructive problems limited to parts of this body area as well as its contributory value to the repair of other anatomical areas, are more fully discussed.

Flame burns of parts or all of both surfaces of the trunk and neck are common in civil life particularly among children and older females whose clothes provide a flue and combustible material They are also frequent in certain industries and transportation accidents

The immediate and subsequent management of the patient is identical in any burned area (see pp 136 and 153)

Case I Flame Burn of the Thorax Shoulders, Arms and Back. This patient, a girl aged seven, suffered third degree burns of the chest, axillae, shoulders, arms and back from ignited clothing. She was dressed daily for three months and was partially grafted twice with homologous skin which failed to grow This probably resulted from failure to replace and check the large, constant fluid loss, correct the deteriorated blood condition provide proteins, vitamins, and the like as well as proper local management of the burned areas.

The general condition at the time of this examination was precarious. The surface picture is presented in Figure 497 *a b* The large, exuberant, suppurating granula

Fig. 497 Case I flame burn of the thorax, shoulders, arms and back. (See p. 734 for detailed discussion and procedure.)



a b

Fig. 498. Case II flame burn of the lower chest and abdomen. (See p. 736 for detailed discussion.)

tion areas covered a well-organized and contracting fibrous tissue base. Note the areas on the right arm and axilla in Figure 497 *a*, the shoulders and the back in Figure 497 *b*

Whole blood, saline tubs and petrolatum pressure dressing during several days of general care permitted removal of the granulation from the fibrous base by dull scraping and ultimate split skin grafting (0 016 inch) to close the areas on the chest and back. *The general condition did not permit the grafting of the area on the right arm and axillae for three weeks.* Marked contraction of the organized fibrous bed under these grafts occurred ultimately of course. Z plastics in both axillae corrected the condition seen in Figure 497 *d* as well as permitted the resumption of normal arm movement.

The failure of proper care in the immediate acute stage created a precarious general condition and allowed the organization of a fibrous bed, and so forth. It required months of effort to obtain a result which should have been accomplished *in four or five weeks.*

Case II. Flame Burn of Lower Chest and Abdomen. The condition presented in Figure 498 *a* is the situation of this male patient, aged eight at this examination *two years* after the initial burn and treatment of the type discussed in Case I.

He had had four unsuccessful grafting procedures and had an unhealed donor site on the left lower chest and upper abdomen in an area 8 by 4 inches (20 by 10 cm.) also on the right lower thigh, measuring 8 by 13 inches (20 by 32.5 cm.)

The management indicated in the preceding case permitted the discharge of this patient in the healed condition presented in Figure 498 *b* in six weeks.

Keloid—Hypertrophy

Case III. This patient, aged four suffered a flame burn of the right chest and shoulder at the age of two years. The immediate healed scar appeared to be the common hypertrophy that frequently occurs in burn scar It was about half the size of the keloid presented in Figure 499 This invaded the bordering normal tissue *and acquired the present size in spite of three series of x-radiation during two years.* These conditions and their management have been discussed previously (see p. 737)

AXILLARY SCAR CONTRACTION AND RESTRICTING WEBS

Case IV Axillary Scar Contraction, Web Formation and Limitation of Arm Excursion from a Flame Burn Two Years Before This Examination, in a Boy, Aged Ten. Figure 500 *a* presents the condition at this time.

The detail of the corrective procedure is discussed fully under Z plastics on page 221 The result of the procedure is presented in Figure 500 *b*

Retardation of Growth and Distortion of Mammae

Scar formation about and over the breast during childhood and the later developmental period either prohibits or retards the glandular growth and produces varying degrees of distortion. Such scar contraction *after development in the adult period results in pressure atrophy* of an amount commensurate with the thickness and tension of the scarred surface

There are many examples of this disability among girls suffering flame burns and unintelligent care during childhood

Case V A girl aged seventeen had had a flame burn of the right chest, axilla, shoulder and arm at the age of ten. Her situation at the latter age is presented to emphasize the obvious criticisms of her earlier care and its results (*Fig. 501 p.* 739).

First, the area was healed with the help of "pinch" (Reverdin) grafts, which have no proper place in reconstructions where the control of scar contraction and



499 Case III. keloid, hypertrophy (See p 736 for detailed discussion.)

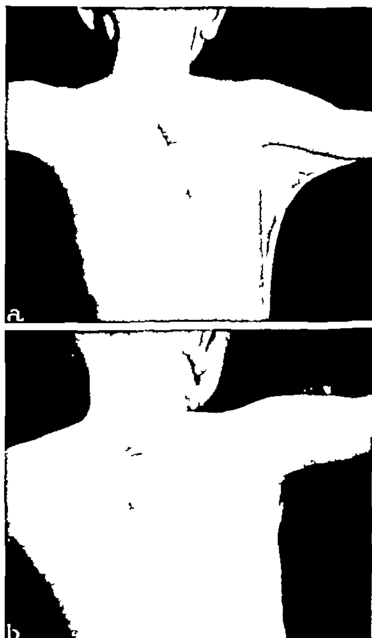


Fig. 500 Case IV axillary scar contraction, restricting webs. (See p 736 for detailed discussion.)

cosmesis are desirable factors. This young girl's entire anterior and lateral right thigh was ruined by the removal of many such grafts (see Types of Grafts, p. 20)

Second, the contraction of the scar surrounding these grafts dragged the areola and nipple into the anterior axillary fold and resulted in a thick, tight scar covering the lateral half of the breast and prevented its growth. Note this and the mesial half of the breast in Figure 501 *b*

Third, the axillary scar contraction restricted the arm elevation to about one half its normal excursion.

Fourth, the bad cosmetic result on an otherwise good body produces marked psychic trauma.

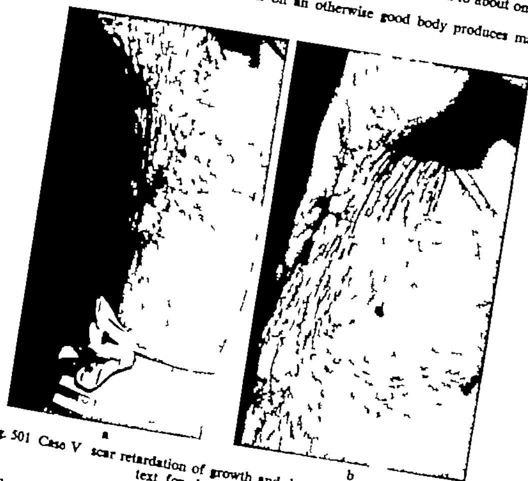


Fig. 501 Case V scar retardation of growth and distortion of the mammae. (See text for detailed discussion.)

The correction of the several disabilities is apparent. The lateral and inferior traction, scar pressure on the right breast and limitation of arm movement is corrected by Z plastics (see p 221 and Fig. 154 p. 223) The cosmetic disability of the shoulder arm and axilla is largely removed by multiple excision (pp. 228–341) The first Z had a central member 3 inches (7.5 cm) long splitting the axillary scar with its center opposite to the nipple. Its lateral arms of equal length had an angle of about 70 degrees. This increased the lateral skin length about 2.5 inches (6.5 cm.) A second Z at a later date with its central member 2.5 inches (6.5 cm) long in the longitudinal plane below the breast, increased this skin length 2 inches (5 cm.) This provided a loose cover and permitted the mesial gland tissue to readjust and bring the areola and nipple near its longitudinal line.

Mamma—Scar Distortion

Case VI. This patient, aged thirty had suffered a flame burn, including clothing, of the left and upper bilateral thorax, axilla neck, chin and face at age four The

loss over the midsternum immediately below the manubrium was deep and extensive its care consisted in dressings only and its ultimate concentric, "purse string scar contracture produced subsequent marked distortion of the breast, areola and nipple on the left side. The direction of the scar traction on the right chest distorted this areola (Fig. 502, *a*) The scar contraction and web in the posterior fold of the

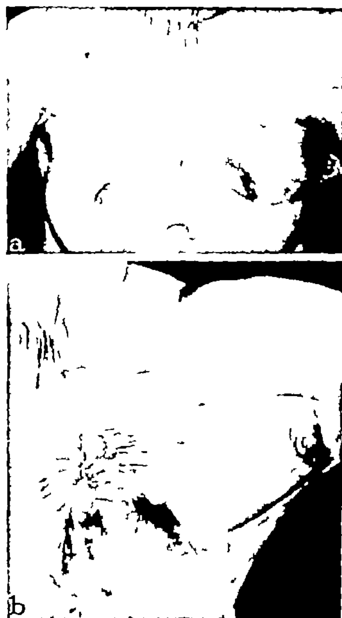


Fig. 502. Case VI mamma scar distortion. (See p. 739 for detailed discussion.)

left axilla attached to the midarm contributed to this distortion (Fig. 502, *b*) Further the scar contraction over the lower sternum between the glands precluded, with the conditions noted, the Z plastic treatment outlined in Case V

A previously delayed, rotated direct skin fat flap . 5 inches (5 cm.) wide raised transversely on the abdomen above the umbilicus and replacing the scar over the sternum to the superior border of the contracted scar mass released the gland tissue from its medial superior traction. A Z plastic correcting the axillary web released the lateral pull and permitted the left breast and areolar tissues to readjust.

MAMMAPLASTY

The breasts may present asymmetries which are various degrees of normal congenital formation and are not conditions for surgical inter ference, developmental anomalies such as the adolescent breast, which probably results from endocrine deficiencies supernumerary breasts and nipples which require simple excision gynecomastia which requires surgical management and the acquired disabilities which are essentially objects of proper surgery These consist of the large breasts and the un usually small breasts which appear so because of flatness but are good functioning glands The latter type of surgery is purely cosmetic

Hypertrophied or Pendulous Breasts

Several types of large and pendulous breasts must be evaluated. Adolescents, who are otherwise normal, present glandular changes in the dependent part of the breast which are probably due to an endocrine imbalance and are not surgical problems large heavy pendulous breasts due to obesity fibrosis and reduction of gland content with or without pregnancy and the flat, saclike breast due to several pregnancies, fat reduction or tight supports

These patients have the same legitimate demand for surgical relief as patients with lipomas fibromas and other benign chronic disabilities

They suffer aching of the back neck and chest due to weight and traction, they acquire a stooped posture with round shoulders dermatitis from perspiration and maceration and limited physical activity of the athletic sort, this leads to a sedentary sluggish life and obesity These things and inability to dress satisfactorily lead to psychic disturbances

The abnormally large breast presents a large percentage of the total cases for consideration of the safe desirable accomplishment of the surgical responsibility

There have been numerous technical procedures advocated and a voluminous reference literature has accumulated and consequently much controversial opinion

Much of this has resulted from lack of accurate knowledge of the circulation involved, or an indifference to it, from lack of appreciation of the structural histology and the actual physiology of such a breast.

These considerations must determine the type and safe degree of cor rection in a given procedure

It is not the author's desire to engage in any phase of this controversial discussion but, rather to present procedures which his experience and observation find safe and desirable

These presentations of both one-stage and two-stage procedures, in which the areola is repositioned in a new locus follow in general the technic described by Barnes which is based on and improves former descriptions and considers fully the excellent discussions and presentation of the vascular supply by Maliniac, and the recent, excellent geometric planning by Aufricht. The planning of the new areolar locus and surface planes is orthodox and does not permit the immediate mathematical exactness of Aufricht's method but one notes some features

which convince him that the late results in this connection will be comparable This plan and Maliniac s contribution are briefly discussed later

General Considerations

1 The *size* of breast which safely permits this reconstruction is not more than three times the normal for the particular body Larger ones are best operated by areolar transplantation and amputation in the manner described and practiced by Thorek. This will be discussed later

2 The *composition* of the breast is a vital factor in this connection. The proportion of fibrous glandular tissue and fat should determine the amount of safe removal and the procedure—one or two stages. This is determined with useful accuracy by palpation.

The fibrous glandular tissue has the better blood supply and permits more incision and excision than does fat.

3 The *physiology* of such breasts permits, in many instances planning without regard of the resultant function. They are either poor or useless nursing breasts. Many cases occur late in the child-bearing period.

The breast consists, microscopically of an infantile gland made up of fibrous tissue and fat with little glandular tissue.

4 *Volume excised* The author believes that excision of more than one third of such breasts is unsafe in a single stage The two-stage procedure in which the areola is repositioned with a posterior skin and gland pedicle is frequently terminated because the patient is relieved of weight and the several other complaints after the first stage and is not interested in the cosmetic result.

These cases are best managed by the method of Thorek, the value of which has been demonstrated by Adams Webster and others in recent years.

Procedure. Planning Relocation of the Areola and the Desired Gland Excision This should be completed and exactly outlined with dye the day preceding the surgery

The location of these lines results from observation with the patient standing, sitting and recumbent. A satisfactory dye is 5 per cent brilliant green in 95 per cent alcohol.

The pattern of the skin incisions determines the final shape and location of the scar

The usual plan of deep excision and fixation of the residual breast to the chest wall varies slightly to meet the particular requirement.

Abduct the breast to locate the submammary groove (fifth interspace) Confirm by palpation and make a short, horizontal line at its center Repeat on the opposite side Connect these two lines with one across the chest. Locate the upper margin of the gland (second interspace) These two borders may vary with the excision and subsequent modeling for the cosmetic result.

Determine the new areolar locus Aufricht does this exactly with his geometric designing. Gillies and McIndoe determine this also in a plane geometric manner using fixed points (the suprasternal and xiphoid notches) on the sternum The author uses the older orthodox procedure

plus variations to suit his problem A vertical line is dropped from the midclavicle The midpoint of the upper arm between a horizontal line through the clavicle and one through the elbow is located and a horizontal line is projected from this point through the vertical line from the clavicle. The intersection is the classical location of the nipple in the virgin breast—midway between its upper and lower border—but is not exactly desirable in an adult breast in which the lower part is larger than the upper and carries the nipple below and lateral to this point. See Figure 503 *a b* (p 744) for result in this typical location and Figure 503 *c d* for added esthetic calculation The selected location is checked in the recumbent position to prevent undesired proximity to the clavicle The round areola in the upright position becomes oval in the recumbent one.

The areola in these breasts is too large for the new modeled one Inasmuch as this structure is to be repositioned as a pedicled vascularized implant, the author does not reduce its size and risk injury to its peripheral circulation The desired size of the new locus is chosen—it may vary from 1¼ to 1½ inches (3 to 3 75 cm) No special marking device is needed. Three galvanized metal washers (1¼ 1½ and 1¾ inches) are included with the instruments The center is placed over the point marked for the nipple and the circumference marked with dye. The border of the areola is ultimately separated with a bevel or diagonal incision ½ inch (1.25 cm) and allowed to contract. This is ultimately sutured into the new locus.

The skin flaps, which, in part, determine the final shape of the breast and participate largely in its continued support, are now outlined. Elevate—abduct—the breast with positive traction Extend the horizontal line marking at the midpoint around the submammillary groove to the level of the nipple laterally and mesially Release the breast and make an exact parallel line on its anterior skin surface Line a right angled V or less if indicated, from the midpoint of the lower areolar border to the base line The skin included in these lines is to be excised

Incise around the areola on a bevel to avoid its circulation. Do not reduce its size but permit it to contract.

Excise the triangular V of skin in the center and the elliptical pieces between the two base outlines Elevate the skin with a gauze sponge and the fingers and do the same over all the breast to uncover the actual gland and well above the existing breast to accomplish the desired elevation of the gland.

Abduct the breast and excise a sector down to the pectoral fascia from a point 2 inches (5 cm) below the areola down to the base point mesially and extending laterally to the axilla. One has in mind the circulatory variations emphasized by Malmiac This preserves a central core for the areola.

If this excision is not adequate for the desired reduction a smaller wedge is excised from the mesial inferior area lateral to the mammary arterial trunks

The superior part of the gland is not disturbed because of the desire

to maintain the function of the long thoracic and mammary vessels after this lower excision The elevated breast is anchored to the fascia over the second rib with two or three 00 plain catgut sutures

The skin flaps are now approximated.

A heavy Dermalon (00) suture is passed through the chest skin and beneath the fascia below the base line point to emerge through the mesial skin flap above its base line and reenter it 1 inch (2.5 cm)

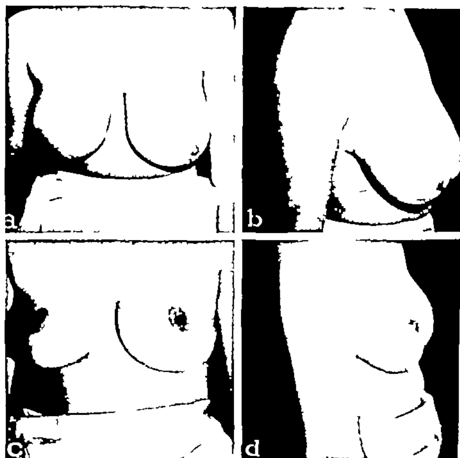


Fig. 503 Mammaplasty *a* and *b* The original condition *c* and *d* the result of the corrective procedure (See p 741 for detailed discussion.)

superiorly pass under the breast fascia and emerge 1 inch (2.5 cm) below the areola, reenter and pass under this fascia transversely to emerge at a similar point on the lateral side, reenter and pass under the breast fascia to a point 1¼ inches (3.2 cm.) above the base line of the lateral flap pass through the skin of this flap reenter the skin 1 inch (2.5 cm) lower down and pass under the fascia and out through the chest skin below the base point.

The sections of this suture above the skin are passed through proper lengths of small rubber tubing to prevent skin scars. The suture is tied *moderately* and *remains ten days.* It compresses the breast into conical shape and maintains it and the skin in proper position during the early healing period. It removes tension from the approximated skin edges

and bastes the skin on the fascia. It is this fascial new scar tissue and anchored skin that form a proper brassiere for permanent gland support

The fascial borders are approximated with interrupted 00000 plain catgut sutures, the skin with 00000 Dermalon lock suture, and the areola with interrupted 00000 Dermalon in the skin only Dress with fluffed gauze, pads and wide adhesive applied as a brassiere

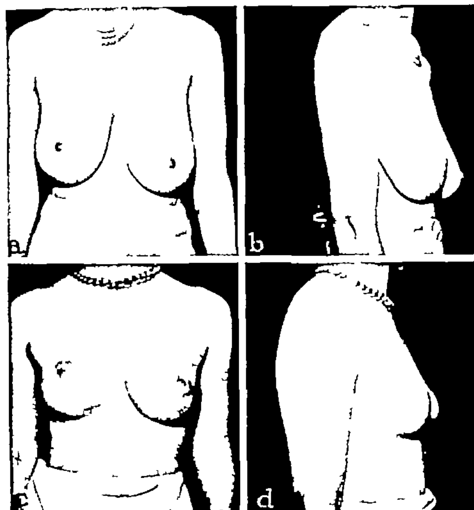


Fig. 504 *a* and *b* The original condition *c* and *d* the operative correction.

Aufricht does not feel that surgical planning must depend upon any particular blood supply He states that "reliance on or avoidance of a particular branch of the mammary arterial tree has no practical value From the surgical point of view all breast tissues are well vascularized There is a sufficient blood supply from any direction of the breast hemisphere to nourish the corresponding tissue" This is of course quite contrary to the general belief and consequent planning throughout many years.

His objective is the "formation of a gently pendent, mature breast." Remodeling of glandular tissue alone is not sufficient. A successful cosmetic result depends largely on the provision of a good "skin bras

siere." The surgical aim is "to cut and make a firmer normally contoured skin brassiere with the consequent formation of a smaller conic breast."

His geometric planning and subsequent technical procedure permit accuracy and produce a result which is acceptable in most respects. His excision of breast tissue does not conform to his statement that "avoid-

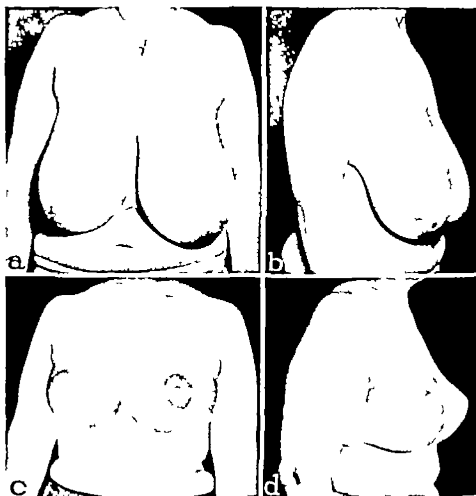


Fig. 505 Mammaplasty *a* and *b* The original condition *c* and *d* the result of the operative correction.

ance of a particular branch of the mammary arterial tree has no practical value " He properly directs that the removal of "entire upper half (or even two thirds)" of a massive breast must be accomplished by incisions which are "divergent from the central axis, *leaving a broad pedicle at the base* Undercutting of the breast is fraught with danger and is often responsible for necrosis of the areola and nipple "

The base of this saucer excision is sutured to the pectoral fascia. If too large a part of the lower breast remains he removes a central sector at a secondary operation

The purpose of this text does not permit the author to present in detail the various steps in this technic. He does, however recommend that

the reader review the original presentation of this excellent addition to our planning and procedure

Malniac has made an excellent presentation of gland, areolar and skin circulation based on the work of Salmon and others making proper injection of the circulation with radiopaque material, x ray studies and dissection

He demonstrates safe areas for wedge-shaped excisions in the superior quadrant between the main vascular pedicles of the thoracic lateral and internal mammary arteries and in the lower quadrant. A balance is maintained between the two main internal and external vascular pedicles. He urges the avoidance of injury to the skin circulation by either close undercutting or tension Large breasts are operated on in two stages The areola is transposed subcutaneously and a wedge in the superior quadrant excised first Excess gland and skin are excised after thorough healing of the first procedure There is little danger of necrosis in this procedure

Free Areolar Transplantation; Breast (Partial) Amputation

Plan the areolar positions, skin flaps, and so forth in the manner previously described the day before the surgery

Procedure.

1 The circular area outlined for the bed of the transplanted areola is circumscribed *to the derma* and the superficial epithelial layers are *carefully dissected taking great care not to enter too deeply* Leave a raw, but not bleeding, surface for the reception of the areola. This is about the depth of 0 2 split skin

2 Circumscribe the areola with a sharp scalpel and dissect it. Transfer it immediately to the prepared bed.

3 Transfix the nipple to the underlying breast tissue with a cambric needle passed vertically through its center

4 Approximate the areola to the skin edge with interrupted 00000 Dermalon sutures on an atraumatic needle The instrumental (fine forceps or hooks) handling should be gentle This is a full thickness graft demanding attention to all the considerations discussed under this heading on page 25 to insure its proper lymph nourishment and subsequent establishment of blood circulation

5 Inciso the entire flap outline Excise the skin included between these incisions The skin and gland incisions for removal must not quite contact the new areolar locus This is added protection against disturbing its blood supply

6 Excise the desired amount of breast tissue. If the breast is wide a lateral and a medial wedge (V) excision permits a more conical breast than the single inferior-lateral one

Return the breast to its pendulous position and elevate the bordering skin for ½ inch (1 25 cm.)

7 Approximate the skin flaps. Suture the fascia with 00000 plain catgut and the skin with 00000 Dermalon Cover the implanted areola with one or two layers of petrolatum or Furacin gauze apply a thick

piece of rubber sponge having a concavity over the areola, and fix with desired pressure with a wide strip of 30 mesh gauze applied to the breast skin with collodion This is not removed until the twelfth day Dress with fluffed gauze and moderate pressure

Abnormally Small Mammae

The alteration of this type of breast is purely cosmetic and is done for improvement of the psychic condition These are good functioning breasts, but their appearance causes much disturbance in certain types of women

Procedure. Incise from the mid upper border of the areola to the upper gland border (second interspace) through the skin and gland to the pectoral fascia

Elevate the gland from the fascia about 2 inches (5 cm.) both laterally and mesially Do this by blunt dissection with the fingers and moist gauze

Overlap the lateral and mesial segments as much as possible without undue tension Fix with several sutures of plain 00000 catgut passed through the fascial layers

Anchor this overlapped gland tissue as high as possible on the pectoral fascia with some simple sutures of 00 plain catgut.

Resect redundant, overlapping skin Approximate. Suture the fascia with 00000 plain catgut and the skin with 00000 Dermalon Dress.

Gynecomastia

This is a physiological development of gland tissue of varying degree, comparable to that of the virgin breast. It probably results from some form of endocrine imbalance in which the secretions of the testicles, adrenals, thyroid and pituitary are principally concerned. It may be accompanied by atrophy of the genitalia female pattern of hair voice changes, and so forth. These are not usual and not characteristic of the condition.

The occurrence is local usually bilateral but may be unilateral most frequently on the left side appearing at puberty

The condition may be mistaken for such pathological states as lipoma fibroma adenoma chronic mastitis, and the like

Successful treatment with x ray or endocrines is reported, but as a rule is not adequate Webster in an exhaustive discussion of the condition states that no cases are cured by endocrine therapy and that *x radiation offers no chance of eliminating the condition.* He states the general belief that surgery is the only adequate management.

He emphasizes the fact that psychic trauma is the important reason for surgical correction which must be accomplished so as to leave the least possible evidence of correction

Procedure. Make an intra areolar incision near the periphery of the inferior half of the areola or laterally and inferiorly if there is gland tissue in the axilla. This results in a better scar than such an incision along the skin junction of the areola.

Dissect beneath the areola, dividing the gland ducts, to facilitate fur ther gland separation and removal. Split the gland, if large and excise in sections.

Split the fat beneath the skin and over the pectoral fascia at a level to provide the desired contour after excision of the fibrous-fat-gland mass. The nipple must have slight protuberance—never retrusion

Approximate the deep layers of fat and fascia with appropriate su tures of 00000 plain catgut and the skin with 00000 Dermalon

Dress with moderate pressure without drainage.

BURNS OF BUTTOCKS AND THIGHS

Case I. This patient, aged six, had suffered second and third degree flame burns of the thighs and trunk up to the nipple line at the age of three. She was hospitalized twenty-six days after the acute burn and returned home against advice as soon as the second degree burn areas on the trunk had healed.

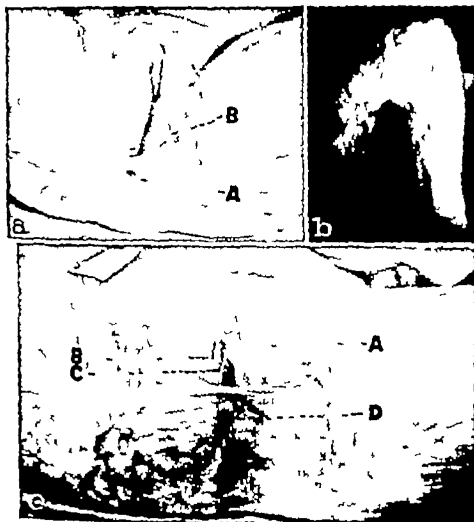


Fig. 506. Case I burn of the buttocks and thighs. *a* and *b* The original condition pubic scar contraction, distortion of the vulva, and maldevelopment of the *labia* (*B*) a and *b* the burn scar curtain over the anus (*A*) and across the thighs. *c* The result of a Z plastic elimination of the scar apron and relaxation of the labial traction. Letters on *c* clitoris, *A* labia majora, *B* urethra, *C* normal anus, D (See text for detailed discussion.)

At the time of this examination she presented contracted third degree burn scars beginning in the middle of both thighs and extending upward slightly above the



Fig. 506 (continued) *d* The result of a Z plastic and lateral iliac scar *e* the corrected structure of the buttocks and perineum *f* the perineal result of the original Z and one on the contracted pubic scar (See p. 749 for detail.)

iliac crests. There was marked contraction of dense scar over her upper posterior thighs and buttocks. This pulled the gluteal cheeks together and extended laterally

to the anterior superior spines. It formed a dense apron extending below the gluteal folds and covered the anus, located 3 inches (7.5 cm.) above its lower border (Fig. 506, p. 749) The scar extended from this lower border upward and inward around the inner and anterior surfaces of the thigh about 2 inches (5 cm.) above and parallel to the inguinal groove Contraction of these scars and a circular one over the mons had completely prevented the development of the vulvar labia and exposed the urethra and vagina to fecal infection.

These disabilities were corrected in three procedures. First, Z flaps with lateral arms at 90 degrees were incised and dissected The central member followed the line of the gluteal cleft. A second horizontal incision bisected the central member The four flaps outlined and dissected were interdigitated. These flaps of dense scar had a precarious blood supply but their transposition served for complete exposure to the anus (Fig. 506 c) They were approximated with Dermalon sutures and covered with aluminum paste to prevent maceration and infection. There was partial loss of these flaps at their distal ends.

Second, sixteen days after the flap procedure, the granulating areas were grafted with skin 0.1 inch thick. This was fixed with 00000 Dermalon suture, supported with a gauze roll containing several irrigating tubes for wet dressing, and fixed with a tensor bandage. See Figure 506 c for the result of these procedures.

Third, six months later the scar band across the vulva was released and a Z plastic performed on the scar mass over the mons. The central arm of a Z 3 inches (7.5 cm.) long was incised vertically through the mass. The flaps and bordering tissues were freely undermined. The relaxation resulting from transposition of these flaps and separation of the perineal skin from the deep fascia permitted the labia minora to approximate and the labia majora to lie in loose folds. Their further development seems quite certain.

DECUBITUS ULCERS

Decubiti occur most commonly in debilitated patients confined to bed for prolonged periods of time They occur with particular frequency in paraplegics

Decubiti most commonly develop over the bony prominences of the pelvic girdle notably the convexity of the sacrum the great tronchanter of the femur and the tuberosity of the ischium. They occur with less frequency over the anterior superior spines, the patella the anterior tibia, Achilles tendon and the malleoli Thin persons are most susceptible

Mechanical pressure over bony prominences causes a local ischemia in the overlying tissues with irreversible degenerative changes if the pressure period is too prolonged or too frequent The microscopic picture is one of progressive local endarteritis with the intima and adventitia of the arteries showing a progressive hypertrophy As the lumina of the vessels diminish in size the blood supply to the area decreases until necrosis and ulceration occur Secondary infection intervenes, and a pyogenic membrane forms over the ulcer Eventually the bony prominence becomes involved in the infection and fibrosis bony degeneration and finally osteomyelitis follow The same micropathological picture of obliterative endarteritis is to be found in the sections of bone underlying the ulcer The veins are not involved

Treatment

The topical treatment of bedsores is directed principally toward the avoidance of further pressure over the lesion and the control of infection. This management may result in healing if the bedsore is relatively

recent. The resulting scar is frequently unstable and recurrences are common

Surgical treatment of decubitus ulcers yields more satisfactory results. This involves radical excision of the ulcer and the underlying bony promi



Fig. 507 Sacral decubitus. *a*, A large lumbar pedicle flap has been "delayed" and bone prominences eliminated *b* lumbar local pedicle flap utilized for closure after excision of sacral decubitus.

nence and the repair of the resulting defect with a properly selected local pedicle flap The result is complete removal of the ulcer and the bony prominence that caused it, and replacement with a durable skin coverage Before any surgical treatment is initiated however the ulcer

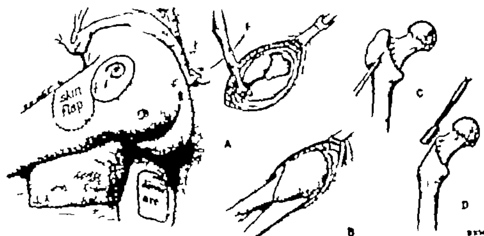


Fig. 508 Trochanteric decubiti must be closed with an adequate local pedicle flap sutured without tension after excision of the ulcer The drawing illustrates a convenient and practical method of closure.

Excision of the underlying bony prominence of the great trochanter is an essential step in the repair of trochanteric decubiti.

must be transformed into a clean wound Chlorophyll ointments and solutions have proved excellent for this purpose A normal blood chemistry must be restored by proper diet and the judicious use of whole blood transfusions intravenous plasma and serum albumin Penicillin

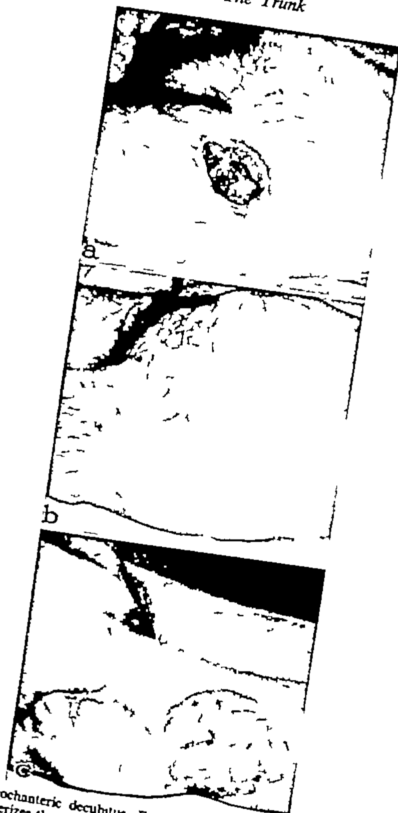


Fig. 509 *a*, Trochanteric decubitus. Extensive undermining around the gre trochanter characterizes these lesions. *b* Postoperative photograph. A sliding loc flap has been utilized for closure. A right ischial decubitus has also been closed wit a local flap and the flap donor area covered with a split-thickness skin graft. *c* Condition 3 weeks after repair of trochanteric decubitus with a delayed loca pedicle flap and split-thickness skin graft applied to the donor area.





Fig. 510 Ischial decubitus. *a*, Closure may be accomplished by partial excision of the ischial tuberosity and coverage with a local pedicle flap. *b* Some type of local pedicle flap is required in the closure of at least 15 per cent of all ischial ulcers.

aregoric and sulfasuxidine in suitable dosages are given for two days efore and seven days after surgery

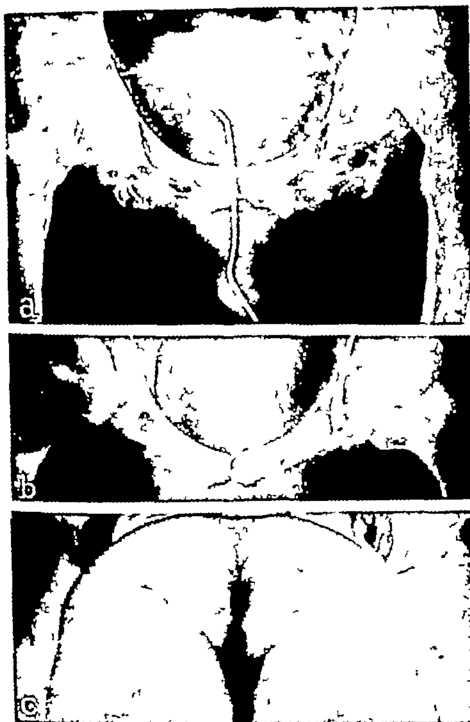


Fig. 511 *a*, Extensive osteoporosis and osteomyelitis underlying chronic ischial decubiti. *b* Bilateral excision of ischial tuberosities. Diseased bone is removed and bony prominences causing recurrences are eliminated. *c* Result 6 months after bilateral subtotal ischiectomy for ischial decubiti.

Patients with reflex muscular spasm are not considered good candi dates for any bedsore repair The assistance of the neurosurgeon may be of value in relieving this condition

Sacral Decubiti. The repair of sacral decubiti is best accomplished by excision of the ulcer and projecting bony spines and the use of a suit-



Fig. 512. *a*, Recurrent right ischial decubitus surrounded by scar. No local tissue is readily available for repair by a local flap. *b* Two months after repair by subtotal ischiectomy and simple closure by suturing adjacent tissues.



Fig. 513 *a* Bilateral ischial decubiti. The right is undermined extensively. This patient has considerable reflex muscular spasm. *b* Undermining demonstrated. All the scarred, pigmented skin must be excised. The extent of undermining is made obvious by application of methylene blue. *c* The extent of tissue excision outlined. It is essential that the ulcer be excised in toto. *d* A sterile crown of oiled silk has been sutured over the wound to reduce contamination.

ably designed local pedicle flap to fill the surgical defect. A large lumbar flap with checked adequate circulation is particularly useful. A split thickness skin graft is used to cover the donor area. Split thickness skin

grafts may be applied directly to the ulcer as a temporary expedient (Fig. 507 p 752)



Fig. 514 *a* Ulcer excised down to the ischial tuberosity Frequently the ulcer is left as a crown on the tuberosity when there is any evidence of continuity of infection into the bone. *b* Gigli saws have been introduced through the obturator foramen.

Trochanteric Decubiti. Trochanteric decubiti are widely undermined The ulcer frequently breaks into the trochanteric bursa and fol

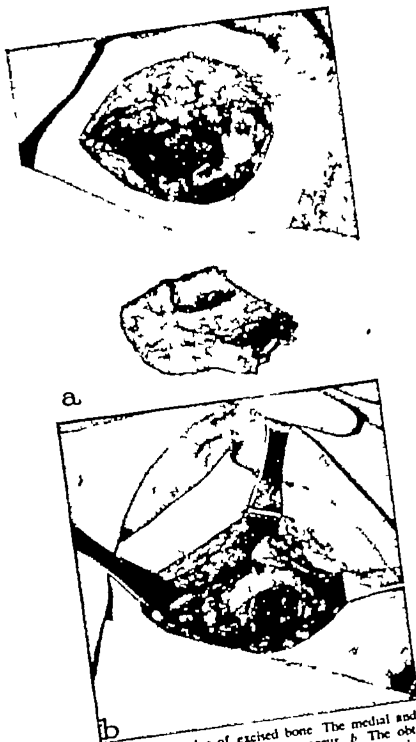


Fig. 515 *a* Triangular wedge of excised bone. The medial and lateral ischial rami are now trimmed back further with a rongeur. *b* The obturator internus muscle now drops down over the cut surface of bone after excision of its bony fulcrum. Gelfoam helps control bone bleeding.

lows its outline An extension of osteomyelitis of the great trochanter into the neck of the femur may occur, requiring resection of the upper third of the femur Sinus tracts may extend from the trochanteric decubiti into the hip joint. Surgical repair consists in total excision of the ulcer and its lining, amputation of the great trochanter and closure by a properly selected local pedicle flap A local flap can usually be shifted from the anterior thigh and its donor area covered with a split skin graft. An S plasty is useful in some instances where closure can be accom

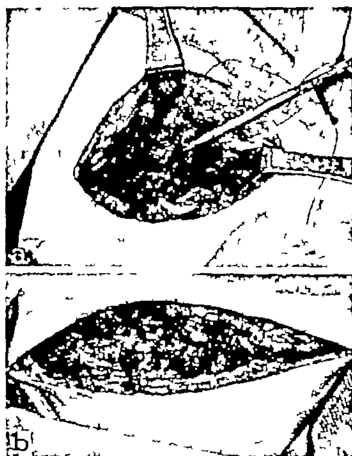


Fig. 516. *a*, The obturator externus is sutured to the obturator externus and biceps femoris over the cut surface of the lateral ramus. *b* The wound falls together with ease.

plished without tension A single sliding flap may be used effectively where the lesion is small

Motion of the femur under the flap thereby causing hematoma occurs frequently in paraplegics owing to the extreme difficulty of immobilizing the legs. These repairs should be dressed early and often and the hematoma evacuated immediately Wound disruptions of some degree may result from a hematoma The wounds ordinarily heal readily without any serious tendency to break down when the underlying bony prominence has been removed (Figs 508 509 510, pp 752 753 754)

Ischial Decubitus. The original method of repairing ischial decubiti followed the principles listed above and included excision of the ischial tuberosity in part, with closure by a local pedicle flap A new and more radical method has proved simpler and more satisfactory The ulcer is excised Gigli saws are passed through the obturator foramen and the ischial tuberosity is completely excised The ischial rami are trimmed further with a rongeur the lateral excision continuing until the bony fulcrum supporting the obturator internus muscle has been removed. Bone bleeding is controlled with "Gelfoam" The obturator internus muscle is then fanned out and sutured over the lateral ramus to the obturator externus muscle and the cut origin of the biceps femoris muscle. It is then usually possible to close the wound by simple primary closure using local tissue to fill the entire defect without the use of flaps.

The sitting patient is now able to carry his body weight on bony prominences which are covered with an ample padding of muscle, fat and skin and the use of complicated muscle flaps is obviated. The patients who are able to walk on braces have shown no evidence of pelvic instability Healing time is markedly decreased. About 15 per cent of this group require an added local flap to effect a comfortable closure (Figs. 511–517 pp 755–761)

Complications

Hematoma is much the most common complication in decubitus surgery Hematomas develop in wounds where hemostasis had been complete at the time of closure There is good evidence that surgical manipulation produces a reflex vasospasm in paraplegic patients when the operation is below the level of the spinal lesion With cessation of *such stimuli and after* the wound has been *dressed vasospasm disappears* and bleeding occurs Occasionally toward the end of a long procedure the operator will see vigorous bleeding suddenly begin from many sources indicating an abrupt end to the inhibiting vasospasm This complication is best treated by careful attention to hemostasis, early and frequent dressings, and the proper use of rubber drains in select cases.

Infection can usually be controlled by penicillin given prophylactically and by limiting surgical repairs to "clean" ulcers only Careful technic must be observed to prevent contamination by the ulcer

Recurrence can be prevented by the complete excision of diseased tissue including all diseased bone and all sinus tracts Methylene blue used to outline the boundaries and ramifications of an undermining ulcer is helpful. Flaps must be planned in such a way as to prevent suture lines over bony prominences Tension must be avoided or recurrence is virtually certain

The author is indebted to Ralph Blocksma for a personal communication giving the technical detail and case illustrations which he has accomplished in association with Joseph Kostrubala at the Vaughn Paraplegic Center under the direction of Paul Greeley





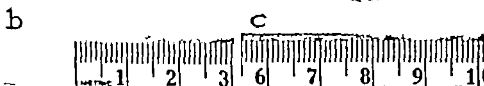


Fig. 517 *a*, This wound healed by primary intention. The procedure must be repeated on the left to equalize the two sides. *b* and *c*, Excised bone and ulcer Pathological examination of these excised ischial tuberosities show diseased bone in 75 per cent. Twenty five per cent show osteomyelitis.

BURNS OF THE ABDOMEN

Burn scar contraction on the lower abdomen and over the inguinal areas, as well as deep burns with gland and lymphatic duct destruction in the latter area produces several disabilities of distressing consequence

Such contraction above and lateral to the mons pubis results in failure of development or distortion and pressure atrophy of the labia and exposure of the clitoris, urethra and vagina, with consequent infection (see Fig. 506 *a, c d* p 749) It may be annular—"purse string"—in character and produce the result presented in the following case

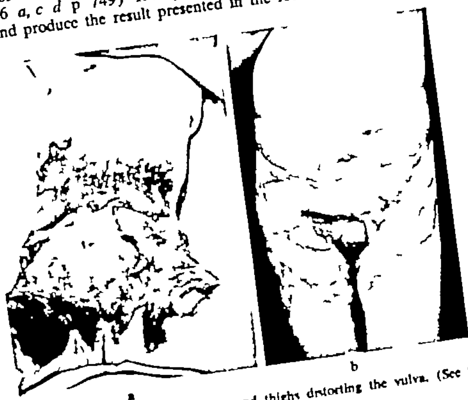


Fig. 518. Burn scar of the abdomen and thighs distorting the vulva. (See text for detailed discussion.)

Inguinal scar frequently limits thigh movement. If destruction and contraction are sufficiently deep to destroy lymph ducts and glands lymphedema results from obstruction of the return flow from the legs to the axillary lymphatics.

Case I. Burn Scar Distorting the Vulva. This child, aged four suffered a flame burn of the upper thighs and abdomen. She was hospitalized for several months before this examination. The result of this long period of care is presented in Figure 518 *a*.

Her condition was such, after two weeks of general preparation, that the lower abdomen and left thigh were grafted with split skin (0 016 inch) seven days later a similar graft was applied to the upper abdomen and right thigh and, thirteen days after the second procedure, grafts were applied to residual areas in the upper abdomen.

The deep scar contraction in the upper half of the labia and the mon resulted in the distortion presented in Figure 518 *b*



Fig. 519 Burn scar contraction along the inguinal canal limiting movement. *a* and *b* The original condition—pinch grafts *c* the result of Z plastic correction. (See p. 764 for detailed discussion.)

Burn Scar Contraction Along the Inguinal Canal Limiting Movement

The patient discussed on page 254 (Figs 176 177) is mentioned here to emphasize the uselessness of Reverdin ("pinch") grafts in preventing or controlling extensive scar The origin of and result of the application of such grafts is presented in Figure 519 *a b*

The marked contraction of inguinal scar and so forth seriously limits the movement of the thighs

The simple and effective method of correction of the functional disability is a Z plastic (see p 221) as presented in Figure 519 *c*

Deep Tissue Destruction and Scar Obstructing Lymphatic Circulation

Third and fourth degree burns or other deep tissue destruction along the inguinal canal and its bordering structures occlude the lymphatics, cutting off the course of circulation up the axillary trunks to the gland area and so on in the axilla, and produce chronic lymphedema of the extremities.

This condition is discussed in detail on page 831 under Extremities.

Tubes and Flaps

The abdomen primarily the thorax secondarily and a combination of these areas thirdly are the principal sources of large amounts of skin both full thickness and intermediate split portions The former and less frequently, the latter are utilized as free grafts.

The outstanding value of this skin area is the ability of transferring it and its attached fat, either locally or at a distance, with certainty of its viability in one of several manners This may be a rotated, interpolated flap a direct flap applied to an approximated extremity transfer on a tubed pedicle which may be adequate for transposition in the vicinity or on a "carrier" such as the arm where it may be transferred on either a tubed or a double flat pedicle

A direct flap with tubing of a part of its pedicle to close this raw surface, is frequently indicated at an initial procedure.

Direct Flaps

These are the obvious procedure in certain cases and have been used by the author for many years in the correction of various disabilities of the arm forearm and hand. These flaps, from either the thorax or abdomen provide all the normal skin for complete arm covering by multiple excision and so forth It is essential in some cases to plan the flap along the posterior axillary line elevate it and tube the part which is not immediately applied This was indicated in a female infant to avoid a scarred anterior thorax Note the result in this patient at the age of twenty two (see Fig. 549B p 798)

Figure 549A (p 797) presents a direct flap from the thorax and axilla immediately applied to the entire anterior arm as the initial stage of a multiple excision

Figure 554 (p 804) presents a direct axillary flap applied posteriorly to the arm and elbow to replace a burn scar; Figure 556 (p 807), a direct abdominal flap to repair a burn scar on the forearm

Thoraco-Epigastric Flaps

The planning and construction of this flap were discussed on page 11 (Figs 11 and 12) The case shown in Figure 520 is pre-

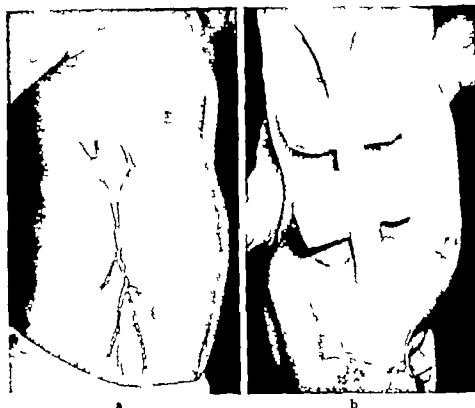


Fig. 520 *a*, Thoraco-epigastric vein. *b*, thoraco-epigastric tube, including this vein. (See p 11 for detailed discussion.)

sented here again for emphasis The flap is constructed and used to correct the inguinal scar contraction and burn scar on the thigh (Fig. 574 p 830)

Pedicled Flaps on a Carrier

These flaps, planned and constructed on the abdomen or chest, are attached to an elevated skin flap of the forearm wrist, and so forth as the new fascicular base permitting the transfer of a viable flap to a distance These are frequently utilized on the head, neck and legs.

The vascular base or pedicle may be a tubed pedicle carrying a flap or a double flat pedicle as described by Cannon and others.

Examples of the tubed pedicle are presented in Figures 39 290, 521, 583 and 584 (pp 57, 435 766 841 843)

The flap with the flat pedicle is presented in the following section

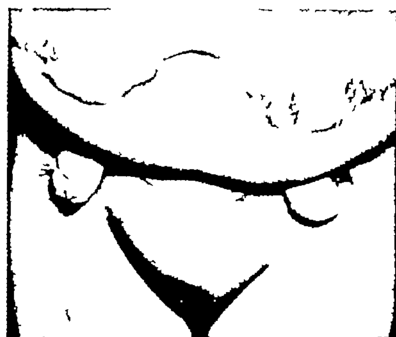


Fig. 521 Transabdominal tube (See p. 841 for detailed discussion.)

Open Jump Flap

The term is introduced by the originators of a technic utilizing a broad flat pedicled flap in the place of a tubed one though it is neither "open" nor does it move from its origin to its destination more abruptly, without intermediate steps than do other viable flaps from a distance

It utilizes the same skin and fat. It suffers the same fibrous tissue formation and contraction and the same elastic fiber and cellular changes in its pedicle as a tubed one The free distal flap behaves the same in both instances

Successful bone tendon and nerve repair depends upon elimination of scar and the good circulation of a proper skin covering. Consequently flaps rather than grafts are essential Osteogenesis frequently follows such a situation where the presence of scar has prevented any regeneration

Requirements. (1) Sufficient mobility of the arm and leg for comfortable flap approximation (2) selection of the arm to carry the flap and the site of its arm attachment in order to accomplish the transfer with the least discomfort (3) a flap larger than the defect to allow for contraction of its pedicle

Procedure Outline long, narrow flaps on the arm and abdomen or chest The length and width of the flaps are determined by the dimensions of the defect (Fig 522, *a* p 767)

Delay the abdominal or chest flap by incising and elevating inferior areas until the desired size to approximate the arm flap and its raw bed has an adequate blood supply

Incise and separate the arm flap Reflect and suture it to the posterior

surface of the body flap with 00000 plain catgut along a line that permits approximation of this body flap to borders of the defect in the arm Suture with 00000 Dermalon (Fig. 522, *b*)

Allow a minimum of three weeks for healing of the approximated flaps and the early establishment of a new circulation Incise the borders and partially separate the remaining base of the body flap Resuture

As soon as adequate circulation from the arm base can be established by test (see p 11) the flap may be transferred to the leg defect. The body defect remaining after separation of the flap may be closed with a rotated interpolated flap Cannon and others prefer to split skin-graft this area



Fig. 522. Direct flap Cannon's jump-flap." (See p. 766 for detailed discussion.) (Courtesy of Dr Bradford Cannon.)

Place the patient on an adjusted operating table so that the arm and leg may be approximated at the desired level Remove all the scar down to a normal bed that may be covered by the flap Suture with 00000 Dermalon, dress, fix and support with a plaster dressing (Fig. 522 *c*)

The separation of the arm pedicle and remaining body flap is a de laying" process until adequate circulation from the implanted flap is assured.

The remaining leg scar and so forth is now excised and the flap sutured in this defect The arm pedicle flap is approximated in its original bed (Fig. 522 *d*)

A broad, flat, pedicled flap has been accomplished in the place of a tubed (circular) pedicle attached to the arm and carrying an initial flap managed in similar manner The author does not agree that this is a "time-saving" technic, but he does recognize that it is a safe, efficient, added method of accomplishing the desired result. Compare with Figures 574 583 584 and others The several essential "delays" in the procedure equal an adequate period for the preparation and transfer of a tubed pedicle flap.*

*The author is indebted to Dr Bradford Cannon for the excellent illustrations of this procedure.

GENITALS

The reconstructive—plastic—surgeon's responsibility is properly limited to *surface and associated* deeper lesions which result in cosmetic, psychic and functional disabilities It is frequently difficult to determine the limitations of special types of technical performance. There should be an eager and helpful collaboration of the plastic surgeon and several others of the surgical specialties in planning and performing technical correction of numerous types of disabilities.

The following case (p 769) is an excellent example of the combined interest of two surgical specialties The review of the various conceptions and plans of management, the behavior and consequent value of various flaps, the proper appreciation of scar formation and its certain contraction the vital effects of poor and adequate blood supply the handling of tissue and so forth are common essential considerations in several phases of both It is not the author's purpose to comment upon individual desires and abilities but, rather to refrain from the discussion of other special problems in a general plastic text.

The repair of surface losses and the desirable management of congenital nevi and so forth and so on, have been discussed previously Examples of the latter are presented for the sake of emphasis

Hypospadias*

Hypospadias is a congenital abnormality in which the opening of the urethra is situated upon the under surface of the penis In the more extreme forms the associated anomalies of chordee micropenis, cryptorchidism cleft scrotum testicular hypoplasia and congenital hernia may be present. The anomaly is classified according to the site of the urethral orifice as (1) glandular (2) penile (3) penoscrotal, and (4) perineoscrotal It is said to occur once in every 300 to 350 males, the glandular form representing the majority of these Fortunately this mild form is of no clinical significance In those persons with more marked deformity ventral chordee is present to a variable degree a situation rendering coitus difficult or impossible The location of the urethral meatus may compel the unfortunate person to void from the sitting position in order to prevent wetting of the clothing. These visible expressions of the deformity are fraught with grave psychic implications.

The chordee or ventral curvature of the penis, is due to fibrous bands which involve Buck's fascia and the intercavernous septum suggesting a shortened remnant of the undeveloped part of the corpus spongiosum The last structure is often thin [illegible] delicate and the urethral meatus may be small or even multiple [illegible] folds resembling [illegible] may extend forward from the [illegible] along the under[illegible] the penis and in the extreme [illegible] a striking resemb[illegible] female genitalia is observed [illegible] a careful di[illegible] be made between hypospadias [illegible]

nostic measures such as cystoscopy pyelography skeletal roentgenography and hormone excretion studies

Procedure. *Stage 1* The first step is to eliminate the chordee by excising the fibrous bands on the ventral surface of the phallus Several methods of performing the first-stage procedure have been devised and any satisfactory technic must give a resultant rearrangement of the penile skin that will be most applicable to the type of urethroplasty contemplated at a later date The preputial hood may be transposed after circumferential incision behind the glans by the button hole the dorsal slit, or the "sliding-collar" technic (Fig 523) Each results in a varia

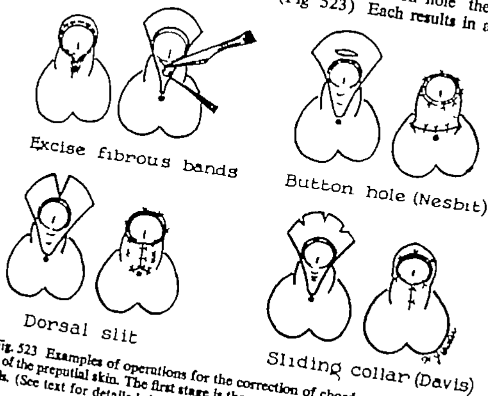


Fig. 523 Examples of operations for the correction of chordee and the transposition of the preputial skin. The first stage is the careful excision of the ventral fibrous bands. (See text for detailed discussion.)

tion of the final distribution of redundant skin Many surgeons attach the glans penis to the abdominal wall with temporary sutures so that the organ is put on a stretch during the immediate period of healing in order to reduce contracture of the ventral surface and promote maximal dorsal correction. If chordee persists after sufficient time has elapsed for all evidence of inflammatory reaction to subside further surgical correction should be undertaken before proceeding with the construction of the urethra. This period of healing usually requires at least six months

Stage 2 The construction of the urethra may be contemplated at an early age or whenever the size of the penis permits The erect organ should be straight and all evidence of inflammatory reaction, subsequent to previous surgery absent. The object is to provide an epithelial lined tube which is continuous with the abnormally placed urethral meatus

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The chordee or ventral curvature of the penis is due to fibrous bands which involve Buck's fascia and the intercavernous septum suggesting a shortened remnant of the undeveloped part of the corpus spongiosum The last structure is often thin and delicate and the urethral meatus may be small or even multiple Epithelial folds resembling labia minora may extend forward from the urinary meatus along the under surface of the penis and in the extreme deformities a striking resemblance to the female genitalia is observed. In some cases a careful differentiation must be made between hypospadias and pseudohermaphroditism using diag-

* The author acknowledges his gratitude and appreciation to Drs Reed N Nesbit and William J Butler for this discussion and the excellent illustrations.

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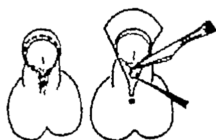








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This tube must be of sufficient caliber to carry the urine and ejaculate to a more normally placed exit on the penis The most frequently utilized operations are those in which the urethra is constructed from skin Thiersch described an operation using two broad-based flaps of penile skin one to form the urethra and the other to cover this defect (Fig 524) The suture lines are not superimposed, so that the tendency for the formation of a urinary fistula is thereby minimized. Duplay s operation is similar in principle but utilized two flaps of penile skin lateral to the skin strip designated for the urethra The urethra is formed by undermining the edges of the strip of skin on the ventrum of the penis

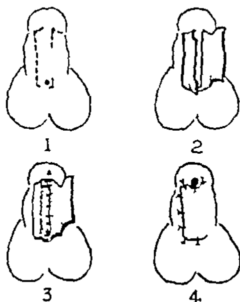


Fig. 524 Thiersch urethroplasty operation (after Cecil) (See p. 769 for detailed discussion.)

and molding it about a stent This urethral tube is not sutured in the Duplay technic, but held in position by the lateral skin flaps which are broadly approximated at the external suture line with quills and silver wire An important modification of this operation as described by Marion and Pérard is to leave the urethral strip intact without dissection of its edges thereby preserving a maximum blood supply Denis Browne of London recently has carried this still further not only leaving the skin strip intact but making no attempt to mold it over a stent (Figs. 527 528) Duplay noted that urethrae formed by his technic developed a linear scar upon healing Browne observes an epithelial lined tube in two weeks after surgery

The urethroplasties formed by these technics are characterized by the relative simplicity of their performance However the success of these operations depends upon sufficient redundancy of the penile skin and failures have been largely due to excessive tension at the suture line with

resultant ischemia, infection and necrosis. As a result numerous operations have been devised to provide skin from other sources the scrotum and prepuce being most commonly used (Figs. 525 526)

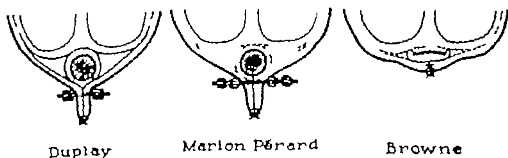


Fig. 525 Comparison of the cross sections of these operations discloses a great similarity with progressive evolution of the Browne operation, in which the skin strip forms a tube unaided by splint or suture.

A different approach to the problem of constructing the urethra is the use of an autoplastic free graft of skin sutured to form a tube, and placed into a tunnel previously constructed through the penis. A splint is left through the tube for several months to insure adequate caliber

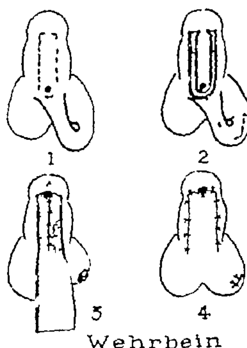


Fig. 526 Wehrbein operation using a double pedicle skin tube previously formed on the scrotum (See text for detailed discussion.)

A pedicle skin flap formed into a skin lined tube (Fig 528) has been used in a similar manner utilizing skin of the prepuce and dorsum of the penis. Other means of forming the urethra from the urinary bladder, veins, vermiform appendix and the ureter have been described by several surgeons, but have had limited applications

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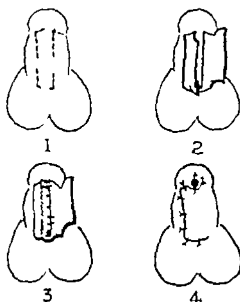


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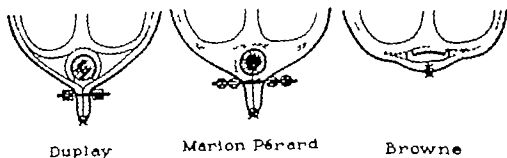


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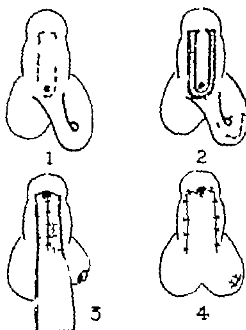


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well to examine the growth patterns that occur in the skin buried beneath the body surfaces Davis and Traut, using dogs observed that full thickness skin grafts sutured to the abdominal muscles and covered with the overlying tissues formed cysts by the proliferation of epithelium upon a base of collagen fibers The accumulation of secretions ultimately prevented further epithelialization Similar results were reported by Zimches who concluded that this phenomenon was a law of epithelial growth. Butcher reported upon buried skin in rats, placing the skin both intraperitoneally and subcutaneously Epithelium proliferated over the opposing surfaces to form cysts or sacs In some cases these cavities remained continuous with the body surface the skin having been left

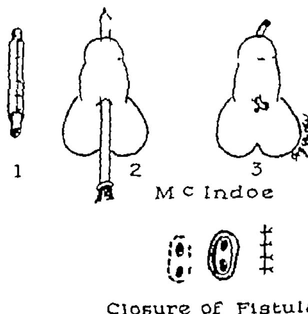


Fig. 5?7 The principle of the free transplantation of skin to form the urethra. A tube of split skin sutured around a trocar is left in a tunnel made by the trocar The new tube is joined to the urethra several months later by closing the fistula.

attached at one point In all cases he observed atrophy of the hair and accessory skin structures, more rapidly and to a greater degree in the deeply buried skin This phenomenon was attributed to the increased environmental temperature about the implant. Peer and Paddock buried small pieces of skin subcutaneously in the human subject removing this tissue at intervals and observed the formation of epithelial cysts followed by degeneration of the sebaceous glands, cystic dilatation of the hair follicles and finally degeneration of the sweat glands by the second month. At the end of seven months the cyst was represented by a wall of chronic inflammatory tissue surrounding a mass of concentric horny material

Nesbit Butler and Whitaker reported an experimental study of skin lined tubes formed from buried strips of intact skin The object was to evaluate the healing processes that enter into the formation of the

urethra by the Denis Browne technic, and the fate of the skin used. The authors suggested the wide application of this method for forming tubes in other fields of plastic surgery The rat and dog were used as experimental animals. A strip of skin was isolated by two parallel incisions and the skin lateral to the incisions undermined to form flaps which were pulled together over the intact skin strip with a subcuticular stitch. The skin strip was thus buried except for the ends, which were continuous with the body surface A subcutaneous tunnel was found to form

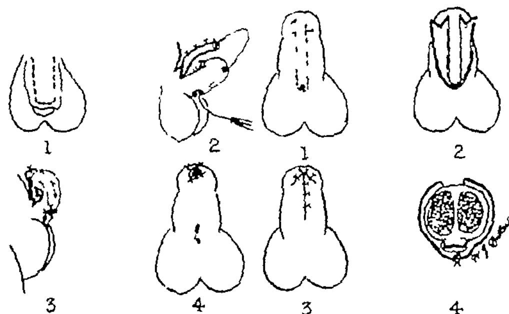


Fig. 528 Fig. 529

Fig. 528 Davis urethroplasty operation utilizing a skin-lined pedicle tube from the dorsum of the penis to form the urethra. (See p 772 for detailed discussion.)
Fig. 529 Browne's urethroplastic procedure using the principle of a buried intact skin strip to form the urethra. (See text for detailed discussion.)

within two weeks which was continuous with the surface at both ends and could be easily calibrated with bougies No splints or stents were left in the tube

The process of healing was studied by microscopic sections at two day intervals (Figs. 530 531 532, 533) Within two days after surgery the epidermis began to grow from the margins of the buried skin and the tissues thereafter appeared to conform to the usual pattern of wound healing when skin defects occur Granulation tissue formed to cover the denuded area, and epithelium extended from the borders to partially cover the defect. Contraction of the wound caused the original defect eventually to decrease in size so that the extending epithelial borders met. This process was observed to occur in twelve days At the end of thirty days, partial atrophy of the original epithelium the hair follicles and the glandular elements occurred. This level of atrophy was

maintained without further regression up to 150 days in the oldest tubes studied

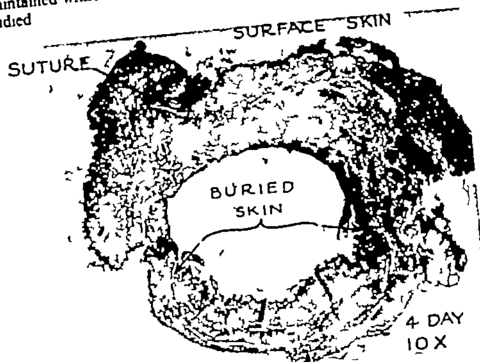


Fig. 530

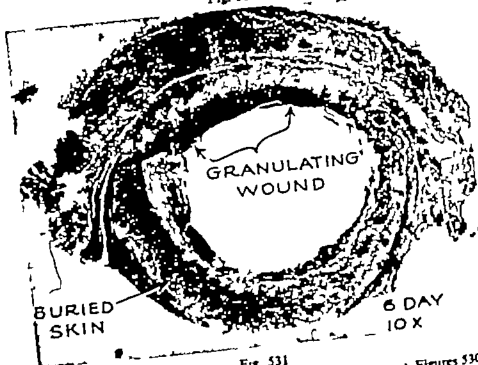


Fig. 531

Figs. 530–533 Cross sections of the buried intact skin strip in a rat. Figures 530–533 demonstrate rapid healing to form the tube between 4 and 12 days after surgery

At two weeks the circumferences of the tubes were variable but demonstrated a marked increase over the original skin strip width. How

ever calibration of the tubes at intervals demonstrated a rapid shrinkage of the flat, newly formed scar and within a period of four to six weeks

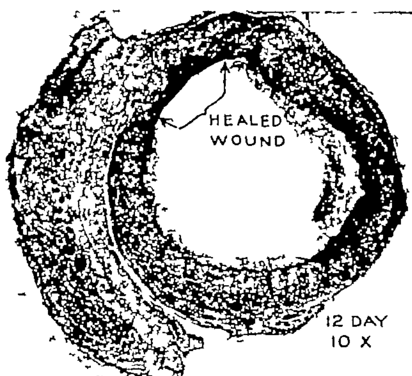


Fig. 532

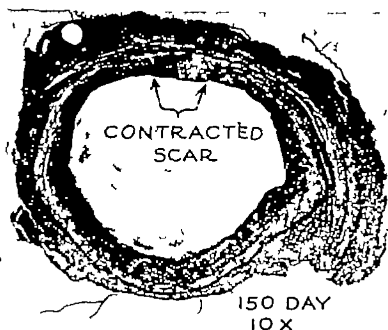


Fig. 533

Figs. 530–533 (continued) The comparatively wide flat scar shrinks in 30 days and thereafter remains about the same in appearance Figure 533 demonstrates the generalized atrophy of the buried skin and the small area of scar at 150 days.

after surgery the circumference was equal to or slightly greater than the width of the original skin strip This caliber was maintained without

further shrinkage (Fig 534) and microscopic sections confirmed the contracture of the scar during the first month The degree of longitudinal contracture was more difficult to measure The tubes formed from narrow strips of skin contracted very little in length while those tubes formed from wide strips of skin displayed greater shortening. This appeared to result from primary shrinkage of the overlying skin rather than from shrinkage of the buried skin.

It is apparent from the experimental evidence that a certain degree of atrophy may be expected in the skin used for constructing the urethra.

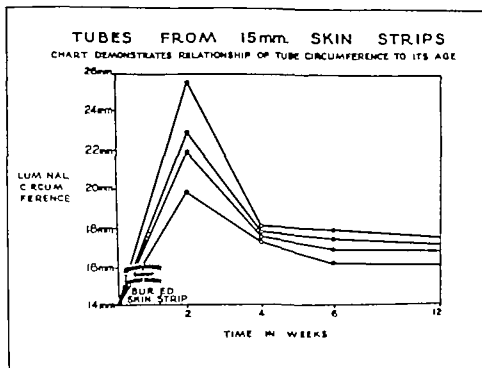


Fig. 534 The graft demonstrates the relatively large caliber attained by tubes formed from buried skin strips 2 weeks after surgery However with the contracture and stabilization of a newly formed scar the circumference rapidly shrinks to slightly greater than the width of the original skin strip This level is then maintained.

Skin tubes formed from buried intact skin strips are practically identical in appearance to tubes formed by primary suture. They have an added advantage of retaining a maximum of blood supply and therefore undergo a minimum of shrinkage This is valuable in estimating the future caliber of the urethra and simplifies the operative problem immensely Urethrae formed by the Thiersch principle have been observed to shrink 30 to 50 per cent of the original caliber In order to anticipate this a broader flap must be used and as a result the adjacent penile skin is often insufficient in amount to cover the urethra without undue tension at the suture line Although the fine hair of the animal and human skin shows atrophy experimentally persistence and even growth of the coarse genital hair has been observed in urethroplasties Therefore it is best

either to use nonhair-bearing skin or to destroy the hair follicles before constructing the urethra.

Diversion of urine must be done by either perineal urethrostomy or suprapubic cystostomy to prevent extravasation of urine into the fresh wound with accompanying infection and the lowering of tissue viability Hemostasis is extremely important, and great care should be exercised to avoid the development of small hematomas during the operation At the end of the operation thrombin solution may be injected into the wound through a dull needle and pressure maintained manually for ten minutes.

Sutures used in the proposed urethral tube must not pierce the epi dermis, or a fistulous tract may form The greatest stress should be placed, not upon the type of suture material used but upon the manner in which it is used.

In summary, it is apparent that numerous and varied procedures have proved satisfactory in the hands of individual surgeons However the operation chosen must be fitted to the patient, and must be dependent upon the configuration of the genitalia and the distribution of the re dundant skin A definite plan of surgery should then be instituted, start ing with the correction of the chordee and ending with the urethroplasty but subject to modification as conditions may require

Avulsion of Scrotum and Skin of Penis

This type of injury has become more frequent with the increasing use of machinery Its incidence, with the exception of torture mutilations has increased steadily since the middle of the nineteenth century when Gibbs (1855) described the first case reported in medical literature More than fifty cases of loss of varying amounts of penile and scrotal skin have been reported since then

Treatment of an injury of this sort may be divided into three separate types (*a*) surgical, (*b*) psychological, and (*c*) endocrinological.

Published reports, almost without exception deal with the details of surgical repair The other two factors noted are extremely important not only for the immediate, but also the long-term welfare of the patient Severe damage to the genitalia in a young man must, in most cases be followed by catastrophic psychological complications which should be treated as soon as possible after the accident. Endocrine and semen studies have shown that a testis apparently normal on clinical examina tion may be temporarily or permanently nonfunctional. In the latter eventuality replacement therapy should be started before castration changes have become evident and have created a disturbed mental state in the patient. A broad concept of a therapy to replace the "surgical minded" viewpoint alone is important.

Surgical Treatment:

1 *Requirements*

A. A soft, flexible cover for the penis which will facilitate return of sensation

B Provision of an adequate protective cover for the testes which will preserve their physiologic function and permit normal activity

It is now generally agreed that the denuded penis should be covered with a skin graft immediately, and that the testes should be buried in pockets in the thighs or inguinal regions as a temporary or permanent site Should the patient not be seen until several days after the accident, the bed for grafting may be prepared by blunt removal (dull scraping) of the inflammatory exudate to a firm bleeding surface It is advantageous to inject a mixture of penicillin and streptomycin beneath the graft to aid the "take" on an infected surface after the graft has been applied The most satisfactory cover for the penis is a dermatome graft 0 016 to 0 018 inch in thickness. This will resemble the normal skin The graft margins should be staggered to prevent a straight line scar contracture. The initial tightness rapidly relaxes owing to repeated physiologic stretching and, provided the graft is applied without tension no difficulty should be encountered The return of sensation in a graft of this thickness which has been placed upon a raw nongranulating bed may be complete in several weeks

When fragments of the scrotum remain these should be scrupulously preserved if they are moderately large for continual stretching will result in the formation of a fairly satisfactory sac. When the entire scrotum has been lost, however—often with a considerable amount of the skin of the perineum—the testes must be buried in the thigh or inguinal region The sterilizing effect of prolonged exposure of these organs to a temperature above that normally encountered in the scrotum is well recognized. It is obvious that a normal thermoregulatory sac cannot be constructed owing to the thickness of a skin flap and its relative rigidity However the temperature in a reconstructed scrotum suspended on a narrow base might be low enough to permit normal function of the spermatogenic and interstitial cells of the testes Scrotal reconstruction is imperative in patients where it is important to preserve fertility for psychological and physiological reasons. The following case illustrates the use of a pedicle flap from the thigh

Case I. The patient aged seventeen, was injured by the revolving shaft of a planer in a saw mill.

The right testicle, the entire scrotum skin of the penis, some skin and subcutaneous fat over the lower part of the pubic region and posteriorly to within 1 cm. of the anus had been avulsed (see Fig. 535 a p 779) The patient arrived at a hospital for definitive treatment two days after the accident.

The entire wound was covered with gray purulent exudate which was removed down to a fresh bleeding surface by blunt scraping. Split skin, 0 016 inch thick, was applied to the denuded area and penis. The mucosal inner surface of the prepuce which was not avulsed, was turned back to join the split skin in covering the shaft of the penis.

It was considered that this prepuce tissue would be physiologically more normal than a skin graft, but, subsequently it was found that persistent marked edema necessitated replacement with split skin.

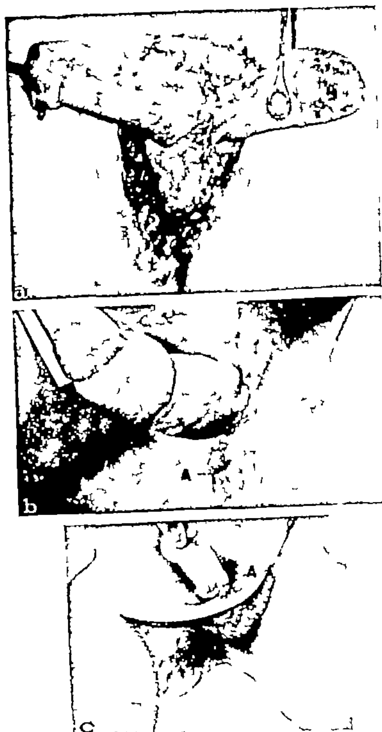


Fig. 535 Avulsion of the scrotum and skin of the penis. *a*, Condition 2 days after the trauma. *b* Split skin (0.016 inch thick) grafted on the penis the mucosal inner surface of the prepuce turned back as part of the covering; the perineum repaired with undermined, advanced skin (*A*) *c* Flap from the right thigh for construction of the scrotum and a smaller flap from the perineum and posterior surface of the penis to prevent constriction sutured together at (*A*) (See p 778 for details.)



Fig. 535 (continued) *d* Incision and elevation of flap and perineal skin *e* implantation of testicle below the external inguinal ring and suture of the flaps over the testicle *f* result of the procedure *g* condition several months after completion of surgical repair (See p 778 for details)

The perineum was repaired by undermining and approximating flaps in the inguinal region (Fig. 535 *b*)

The patient stated that he would not return home without a scrotum conse quently this construction was undertaken A rectangular flap of desired dimension was outlined on the right thigh and delayed (Fig. 535 *c*) This was elevated and sutured across the perineum at the root of the penis to form the anterior wall of the scrotum. A small flap raised from the perineum and extending a short distance down the posterior surface of the penis was sutured to the flap to prevent construction (Fig. 535 *a*)

The denuded area on the right thigh resulting from the elevation of this flap was covered with split skin. The base of the flap was periodically incised until its new



Fig. 536. Biopsy section showing almost mature sperm. Thickening of the wall shows activity No mature sperm in the tubules

blood supply was assured The perineal skin covering inferior to this flap was inched elevated and sutured over the transplanted remaining testicle (Fig. 535 *d e f* p. 780)

A psychiatric examination of the patient upon admission established that he was a psychoneurotic, prone to accidents, and that he had been involved in three such accidents during the previous two years. Psychotherapy was carried out during his stay in the hospital to aid him in reaching an adequate emotional reaction.

The transplanted testicle was located below the external inguinal ring and on palpation appeared to be normal in size and consistency The superficial surface temperature beneath the skin was 95 6 F., and on the deep surface of the testicle was 96.2 F A semen specimen showed azoospermia on two occasions. This was thought to be due to a nonpatency of the vas, but the steadily rising values of gonadotropins in the urine (see Table 3) indicated the severe damage to the interstitial and spermatogenic cells. Testicular biopsy showed some seminiferous tubules to be atrophic, while others were relatively normal No mature spermatozoa were found. Normal interstitial cells were somewhat reduced in number The fact that the gonadotropins were falling to a lower level in the last specimen appeared to indicate an improved

TABLE 2.

Date	17 Ketosteroids Mg./24 hrs.	Creatinine Gm./24 hrs.	Gonadotropins (Urine) Mg./24 hrs.	Semen Examination	Testicular Biopsy
1948 Nov. 6	16.3	1.8	52.8	Volume 3 cc. Viscosity slightly decreased. Turbidity markedly decreased. Count a number of large drops examined under both low and high power. *No spermatozoa. A few pus cells present*	—
Nov. 18	19.8	1.5	—	—	—
Nov. 19	17.7	1.57	—	—	—
Nov. 20	—	—	52.8	—	—
Dec. 13	—	—	175.0	—	—
Dec. 23	—	—	250.0	—	—
1949 Jan. 17	—	—	—	Volume 5 cc. Slight decrease in viscosity. Turbidity greatly decreased. Count several large drops examined under low and high power. *No spermatozoa. A few pus cells*	—
Jan. 22	—	—	—	—	Pathological report. Seminiferous tubules show irregular proliferation of cells and little evidence of complete spermatogenesis. Some *tubules are well formed* and show nearly mature spermatozoa. The interstitial cells are decreased in number
Jan. 25	—	—	105.6	—	—

response on the part of the interstitial cells of the remaining testis. Testosterone may be administered by subcutaneous injection of pellets through a hollow trocar when indicated.*

TUMORS—NEVI

The tumors benign and malignant, and the various nevi of the trunk require the same management as previously discussed in other areas The location and subsequent behavior of scar as well as appearance merits the same consideration as elsewhere (see p 701, Fig 475)

Case I. A rapidly growing fibrolipoma created a functional as well as a cosmetic disability It had a diameter of 8 inches (20 cm.) and an elevation of 4 inches (10 cm.) (Fig. 537 *a*)

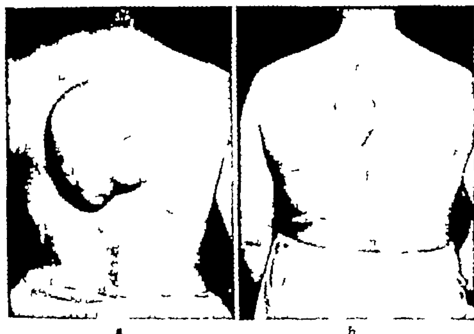


Fig. 537 Case I rapidly growing fibrolipoma. (See text for detailed description.)

An S-shaped (myrtle leaf) incision was made longitudinally through the center and the mass removed by blunt and sharp dissection The small mass to the right was removed through a transverse incision The healed condition is presented in Figure 537 *b*

Case II. A male, aged eighteen months, presented a benign hairy melanoma (Fig. 538, *a* p. 784) The benign character of the mass permitted multiple excision in two stages at an interval of three months (see pp. 228 and 341)

The incision was confined to the mass, the bordering skin was freely elevated, and the maximum of the lesion, allowing approximation, was removed. The results of the two stages are presented in Figure 538 *b* c.

Case III. Capillary Hemangioma with Surface Ulceration and Frequent Bleeding in an Infant Aged Two and One-half Months. This involved the skin of the entire right labia majora (Fig. 539 *a* p. 785)

Excision was made between the elliptical incisions carried to the fascia.

* The author is indebted to Hamilton Baxter for a communication giving details of this consideration and the operated case.

The edges were approximated with 0000 plain catgut and 0000 Dermalon sutures. The wound was sealed with compound tincture of benzoin. No dressing was applied and no napkin until healing occurred.

The result is presented in Figure 539 *b*.



Fig. 538 Case 11 Benign hairy melanoma. (See p. 78[illegible] for detailed discussion.)

Case 1[illegible]. Cavernous Hemangioma Between the Thigh and the Buttock of a Male Infant Aged Two and One-half Months. The mass was 1¾ inches (4.5 cm.) long and 1 inch (2.5 cm.) wide (Fig. 540 *a*).

Excision was made between the elliptical incisions.

The defect was closed by a tongue-shaped flap advanced from the medial thigh and approximated with 00000 plain catgut and 00000 Dermalon sutures. The flap

and suture areas were covered with 30 mesh gauze and oiled silk applied with collodion (U.S.P.)

The healed result is presented in Figure 540, *b*.

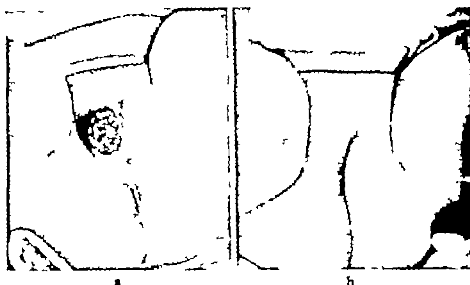


Fig. 539. Case III. ulcerating capillary hemangioma. (See p. 783 for detailed discussion.)

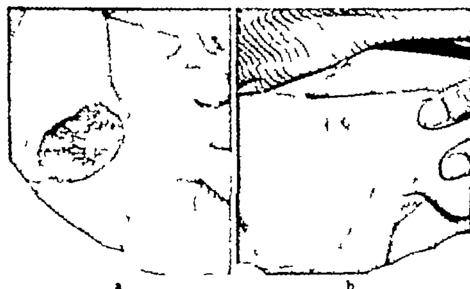


Fig. 540. Case IV. cavernous hemangioma between the thigh and the buttocks. (See p. 784 for detailed discussion.)

ESOPHAGEAL CONSTRUCTION FOLLOWING RESECTION OF CONGENITAL ANOMALY, MALIGNANCY OR TRAUMA

This has been accomplished until recently with extrathoracic skin lined tubes, gut lined tubes (jejunum), or a combination of tubes of this character which joined the upper esophageal stump and the gastrostomy below.

The original jejuno-esophagoplasty was actually accomplished by

Roux in 1907 This was an extrathoracic loop of jejunum sutured to the stomach and carried beneath the thoracic skin to the suprasternal notch in one stage and anastomosed with the elevated esophageal stump in a second stage.

Lexer contributed, in 1911 the basic principle of the major efforts until recent years He sutured the jejunal loop to the stomach in the first stage included the loop in a locally constructed skin tube up to the sternal notch in the second stage and approximated the skin tube and cervical esophageal stump in a third one

The first completed case of the latter type in this country was reported by Ochsner and Owen in 1934 This is an excellent technical presentation and review with a complete bibliography

Ladd and Swenson have contributed largely to the intrathoracic jejunal reconstructions below the level of the aortic arch. Yudin in 1944 reported eighty-eight completed cases in which twenty-one were total intestinal esophagoplasties The increasing choice of procedure during recent years is intrathoracic jejunal or gastric anastomosis when possible and the use of the extrathoracic technic as a procedure of necessity

The responsibility of the former procedure is, obviously not that of the plastic surgeon, nor is he properly associated with the latter except as a collaborator

Chapter XIV

EXTREMITIES

The basic principles involved in the correction of the surface and related deeper disabilities both cosmetic and functional of the extremities are identical with those formerly discussed in connection with other areas There are however some exceptions in certain managements of the hands and feet, but these do not, as a rule become the responsibility of the plastic surgeon. There are some variations in the application of these principles, which are essential to these areas It is the author s purpose to present the various common conditions and discuss in more detail the technical management of the others

SYNDACTYLISM

This congenital condition consisting of some degree of soft tissue approximation of two or more fingers and/or fusion of their cartilaginous and bony components is frequently familial This is true also of poly dactylism—the presence of supernumerary segments or total fingers Fusion of the nerves tendons their sheaths and so forth may also occur

The correction is apparently surgical and its objective is normally developing and functioning fingers without resultant scar limitations and distortions Several types of technic are proposed for correction of the webbing and so on No one procedure seems applicable to all cases, but one of the few based on principles essential to desired scar formation is applicable to a considerable group of cases in the author s experience

It is sensible and safer to operate one side only of a finger during a single procedure Sufficient time is allowed before a second operation to assure the proper organization and function on the first side Hence two involved fingers such as the thumb and the index or the third and fourth fingers may both be operated on at one time but not three adjacent ones Great care must be exercised to avoid injury to vessels and nerves

The approximation lines of flaps and grafts must be offset or staggered to prevent the contractions of long linear scar which limits function and ruins the cosmetic result.

Examples of flaps Z plastics and grafts and useful technical procedures are presented in the following cases.

Case I. A girl, aged seven, had a complete web to the middle of the distal phalanges between the second and third fingers a web between the proximal phalanges of the first and second fingers of the left hand and webbing between the proximal phalanges of the first and second and the second and third fingers of the right hand (Fig. 541 *a b* p. 789)

Procedure STAGE 1 LEFT HAND An inverted V flap with a base equal to the distance between the mid-dorsal line of the second and third fingers and its apex on the line of the normal free margin of the web between these fingers was outlined on the dorsal surface (Fig. 541 *a C*)

A dorsal flap based on the second finger was outlined along the top of the web and along the mid-dorsal line of the third finger to the apex of the flap, *C* This line *A* is the free margin of a flap elevated to the dotted line *B* and based on this finger

A similar volar flap, in a reversed location, was outlined with its base on the third finger

These flap margins and the borders of the flap *C* were incised through the skin and elevated, the fingers separated and flaps folded to cover the denuded surfaces of the separated fingers. The incised border of the normal dorsal skin was incised and the borders of the flap were trimmed to produce an S-shaped approximation line See the third finger in Figure 541 *c* (p 789) The flap *C* was sutured to the volar skin and the approximating margins of the flaps with 00000 Dermalon The result of this stage is presented in Figure 541 *c*.

The suture lines were covered with gauze moistened in 70 per cent alcohol The fingers were separated and fixed to a splint in full extension.

An interval of ten months elapsed.

STAGE 2. CORRECTION OF THE WEB BETWEEN THE FIRST AND SECOND FINGERS An inverted V-shaped flap, *D* was outlined on the dorsum as in Stage 1 A Z flap *E*, was outlined with its central member along the distal margin of the web and its dorsal lateral member along the junction of the web of the second finger (Fig. 541 *a*) The volar lateral arm of the Z ran along the attachment of the web to the first finger

The outlined flaps were incised through the skin dissected, reflected and sutured as in Stage 1 The result of the procedures is presented in Figure 541 *c*

An interval of ten months elapsed

STAGE 3 WEBS BETWEEN THE PROXIMAL PHALANGES OF THE FIRST AND SECOND AND THE SECOND AND THIRD FINGERS, RIGHT HAND The web between the *second and third fingers* was operated on as in Stage 2.

An interval of one year elapsed

STAGE 4 WEB BETWEEN THE FIRST AND SECOND FINGERS. This was managed as in Stage 3 The volar skin about the approximation of the tip of the V flap necrosed and granulated resulting in the reduced web seen in Figure 541 *d* The parents were satisfied with the result and refused further indicated correction.

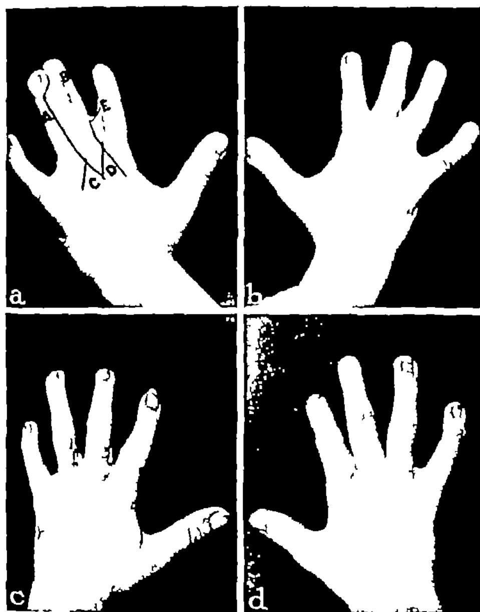


Fig. 541 Case I syndactylism. *a* The original condition and outline of the flap planned for procedure significance of the lettering is discussed in the text. *b* The initial condition in the right hand *c* and *d* the finished result of the procedure. (See p. 788 for detailed discussion and procedure)

Case II. Z Plastic Reconstruction. An infant, aged six weeks, had a complete web between the second and third fingers.

Procedure Multiple Z flaps (see p 221) using the approximating line of the two fingers as the assumed central member were designed on the volar surface as outlined in Figure 542, *a*, and in the same manner on the dorsal surface. These lines were incised through the skin, the flaps dissected the fingers separated, and the flaps reflected and approximated with 00000 Dermalon.

The immediate result of the procedure is presented in Figure 542, *b* and that after six months in Figure 542, *c* Note the scar formation and contraction without distortion along the margins of flaps *A* and *B*

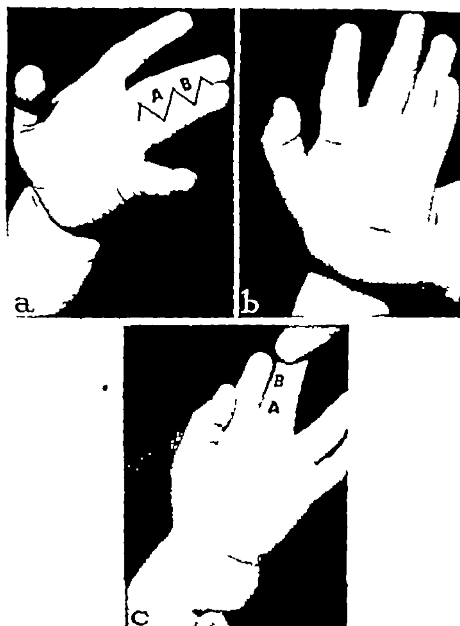


Fig. 542 Case II syndactylism a complete web between the second and third fingers Z plastic reconstruction. (See p 789 for a detailed discussion of the procedure and the significance of the lettering.)

Case III. Flap and Skin Graft (Fig. 543 *a*). A boy aged five had a complete web *of the second and third fingers and lateral (ulnar) displacement.*

Procedure The tension of the skin over these fingers would not permit of complete closure of the approximating surfaces after separation. Consequently a flap of adequate size based on the dorsum of the third finger was incised on the dorsum of the second finger and reflected to approximate the incised volar skin on the third finger The defect on the second finger was covered with split skin from the thigh.

Two months after the procedure above there was slight residual webbing and flexion of the second finger due to scar contraction of the graft. This was corrected four months after the first procedure by reflecting a small V flap from the dorsum into the phalangeal groove The final result is presented in Figure 543 *b*

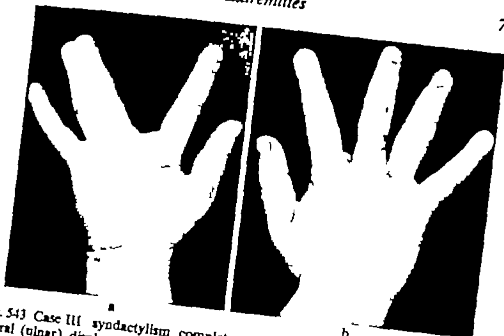


Fig. 543 Case III syndactylism complete web of the second and third fingers, and lateral (ulnar) displacement. (See p 790 for detailed discussion and procedure)

Case IV A boy aged nine, had marked underdevelopment, total web enclosure of four fingers and a partial web between the thumb and index finger of the left hand (Fig. 544 *a b*) The child had been under excellent orthopedic care for other developmental disabilities since early infancy and was referred for this hand surgery at the age noted.

Procedure STAGE 1 RELEASE OF THE FIRST AND FOURTH FINGER.. Inverted V flaps with their points on the line of the palmar phalangeal groove (see Fig. 544 *b*) were outlined and incised as described in Case I (p. 788 and Fig. 541 p. 789) The incision of the remaining distal web, the flap approximations and the split skin grafting of the residual defects were managed as in Case III (p. 790) The result of this procedure is presented in Figure 544 *c d*

An interval of five months elapsed.

STAGE 2. CORRECTION OF THE WEBBED SECOND AND THIRD FINGERS AND THE PARTIAL WEB BETWEEN THE THUMB AND INDEX FINGER The correction of the finger web was the same as in the preceding procedure. That between the thumb and index finger with a Z plastic was as described in Case I (p 788 and Fig. 541) The final result is presented in Figure 544 *c*

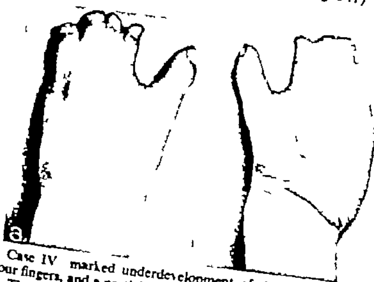


Fig. 544 Case IV marked underdevelopment of the left hand total web enclosure of four fingers, and a partial web between the thumb and index finger of the left hand. *a* The initial condition. (See text for a detailed discussion and the procedure.)

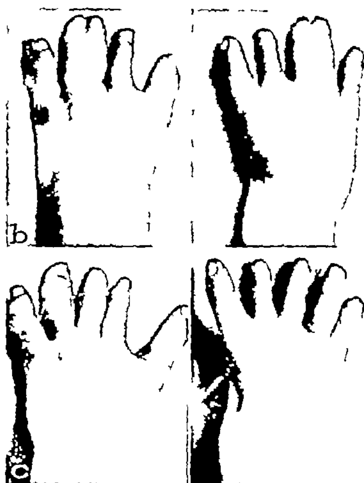


Fig. 544 (continued) Case IV *b* stage in the constructive procedure *c* the result of the procedure (See p. 791 for a detailed discussion and the procedure.)

POLYDACTYLISM AND SYNDACTYLISM

Case 1 A male infant aged one month, had a bilaterally identical anomaly There was an accessory thumb ½ inch (13 mm.) in diameter solidly attached on the distal phalanx of the normal one· a second supernumerary thumb medial to the normal one and attached only at its base the index finger was normal and free· the second third and fourth fingers were held in one movable mass by complete webbing to their tips and there was a small supernumerary finger on the distal phalanx of the fourth one. All joints were movable but limited by union of the fingers.

Procedure STAGE 1 A tourniquet was applied above the elbow of the right arm. The accessory thumb was excised below the phalanx through an elliptical incision about its base which was closed to conform to the normal web.

The bone and fibrous tissue of the accessory on the distal phalanx was completely excised through a longitudinal incision. This was approximated with Z flaps at its midpoint to release the anterior contracture of the thumb The small accessory on the fourth finger was similarly excised

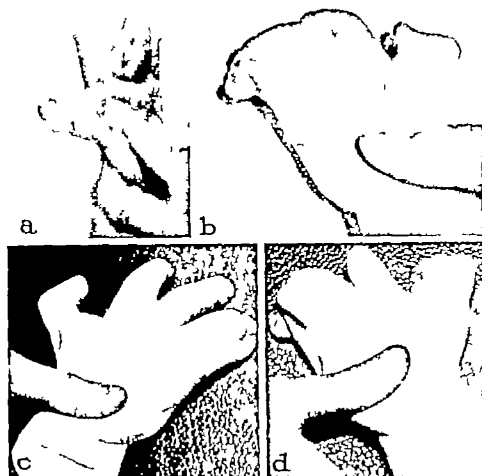


Fig. 545 Case I polydactylism and syndactylism This anomaly is bilaterally identical. *a* and *b* The initial condition, *c* and *d* the early stage in the reconstruction. (See text for detailed discussion and procedure.)

Zigzag and dorsal V flaps were incised on the dorsal surface of the second and third fingers (Fig. 545 *c*) as in Case II (p. 790) The fingers were separated by sharp dissection. When interdigitated these flaps were insufficient to cover the denuded area entirely They were supplemented by grafted split skin.

The accessory thumbs on the left side were excised like those on the right side and this stage of the procedure was concluded (see Fig. 545 *c d*)

An interval of ten weeks elapsed.

STAGE 2. SEPARATION OF SECOND AND THIRD FINGERS ON THE LEFT HAND AND THE THIRD AND FOURTH ONES ON THE RIGHT SIDE SMALL Z PLASTIC ON THE LEFT THUMB TO RELEASE THE CONTRACTURE. These procedures were accomplished as discussed in Stage 1

An interval of three weeks elapsed.

STAGE 3 SEPARATION OF THIRD AND FOURTH LEFT FINGERS CORRECTION OF SMALL WEBS AND SCAR CONTRACTURES. The procedure was identical with the preceding. Release of the web revealed that the distal phalanx of the fourth finger was absent. The accessory finger was removed.

POLYDACTYLISM

The extra digit or part of one may originate from a metacarpal joint or an accessory metacarpal bone from a metacarpal or a phalanx bifur-

cation, or it may have merely a fibrous attachment to a phalanx. The marginal origin is more frequent than the metacarpal one but both may occur together (Case I p 792)

Function blood and nerve supply and so forth must be determined before surgery is undertaken. Tendons may be abnormally located and require transfer to maintain normal function after excision of the accessory digit.

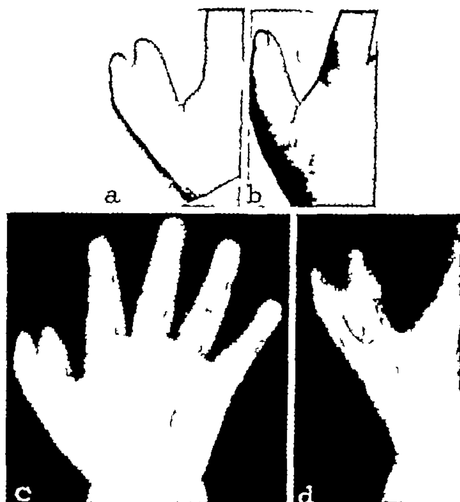


Fig 546 Case II polydactylism a supernumerary left thumb situated laterally *a* The original condition *b* result of the correction *c* and *d* x ray picture of the left hand (See p 795 for detailed discussion and procedure)

A distal phalanx if rudimentary is excised. If it is a bifurcation with good structure and so on the mesial half of each phalanx and the intervening structure is excised and the halves are approximated

An elliptical incision is made around the base of the joint capsule of the accessory finger the tendons are incised and allowed to retract if they are not to be transferred the capsule is opened and the phalanx disarticulated A supernumerary metacarpal should be excised The wound is closed in layers with offset suture lines

Case II. A girl, aged four years, had a supernumerary left thumb situated laterally. The two thumbs had a common articulation with the metacarpal bone. There was a cleft between the two extending to the interphalangeal joint. The phalanges of the accessory thumb were smaller than those of the medial one. A small epiphysis is seen at the proximal end of the proximal phalanx of the accessory thumb (Fig. 546, *a*, p. 794)

A curvilinear incision was made on the radial surface of the accessory the bone amputated, its base attachment shaped and smoothed, and the covering approximated with 00000 plain catgut and Dermalon sutures. A normal thumb with normal function is presented in Figure 546, *b*

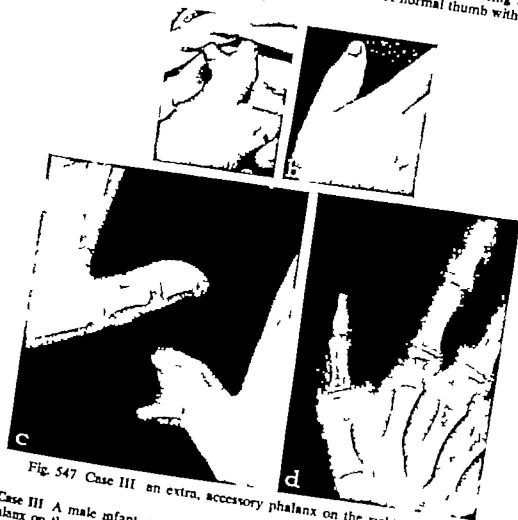


Fig. 547 Case III an extra, accessory phalanx on the right thumb

Case III A male infant aged two and one half years, had an extra, accessory phalanx on the right thumb. The normal thumb structure was somewhat smaller than the left one. There was some enlargement of the distal articulation and phalanx with normal flexion.

X-ray examination of the two thumbs showed a projection on the radial aspect of the right one which contained a terminal phalanx. Both the normal and the supernumerary phalanx had a normal epiphysis and appeared normal otherwise. The phalanx which they shared for articulation had a semilunar contour rather than its normal shape (Fig. 547 *a*)

Procedure A double elliptical incision was made about the base of the extra digit, the soft parts were elevated, and the base was incised with a scalpel and the digit removed. The soft parts were approximated with 00000 plain catgut and Dermalon (see Fig. 547 *b*)

NEVI—PIGMENTED

These congenital conditions are the same as those described previously in discussing other sections of the body. This section is included here not only for the sake of completeness in considering surface disabilities of this extremity, but for the purpose of emphasizing some simple technical managements and the fact that neither a graft nor a flap, other than one bordering the disability, should be applied to any exposed body surface when the surgeon has a choice of procedure.

Case I. A girl, aged eighteen, presented a benign, melanotic, hairy mole as seen in Figure 548 *a*.



Fig. 548 Case I benign hairy melanoma multiple excision.

It is removed by making a "myrtle leaf incision," which confines scar to the limits of the lesion, and three multiple excision procedures (see pp. 228 and 341). The result of Stage 1 is presented in Figure 548 *b* and the final result in Figure 548 *c*.

The stretching of the final scar is simply reduced to the appearance of a normal line or crease of this area after the relaxation of bordering skin occurs in a reasonable period of time.

Case II. A girl, aged four, presented a benign, hairy melanotic mole of the entire arm, elbow and upper forearm. The length of nevus was 9 inches (22.5 cm.) and the width (circumference of the midarm) 8 inches (20 cm.) (Fig. 549 *A*, *a*, *b*, p. 797.)

This lesion was replaced with normal skin by using a direct flap from the axilla and chest and multiple excision. The pathologic finding of no malignancy permitted the latter procedure rather than total excision initially and grafting.

Procedure STAGE 1. A flap of the dimensions noted was outlined from the posterior axillary fold across the thorax to a point just lateral to the areola. This was incised along its length down the fold and along its superior and inferior borders for 5 inches (12.5 cm.). This incised flap was elevated for 3½ inches (8.75 cm.).

The skin bordering the defect posteriorly was freely elevated, advanced and sutured to the fascia at the base of the elevated flap.

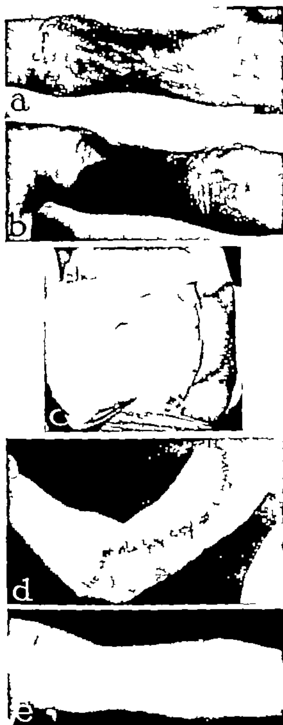


Fig. 549 A. Case II benign, hairy melanotic nevus of the entire arm elbow and upper forearm, direct thoracic flap multiple excision. *a* and *b* The original condition, *c*, the application of the direct thoracic flap *d*, the second stage of flap advancement *e* the result of the procedure. (See p. 796 for detailed discussion and procedure.)



Fig. 549 B. Multiple excision. *Top*, pigmented, hairy mole covering the entire upper arm and shoulder; *center*, tubed pedicle flap from the axilla transplanted to the elbow and forearm; *bottom*, result (6 years later) of transplantation of the skin in the tubed pedicle and subsequent multiple excisions. This transplanted skin ultimately covered the entire circumference of the arm.

The arm was approximated to the chest, the flap stretched with moderate traction over the lesion and its border outlined. This area of the nevus (about one third) was excised. The flap was approximated to the defect with a few simple 00000 plain catgut sutures through its derma and the arm fascia and 00000 Dermalon around its border. The arm was fixed and supported with a plaster bandage (Fig. 549 c)

An interval of four weeks elapsed

STAGE 2. EXCISION OF CHEST FLAP MULTIPLE EXCISION OF THE NEVUS. The chest flap was incised about 1½ inches (3 4 cm) from its arm attachment and elevated. The bordering skin attachment to the arm was incised, the bordering nevus freely elevated, and the maximum permitting proper approximation with the skin excised (see Multiple Excision, pp 228 and 341)

An interval of ten months elapsed

STAGE 3 MULTIPLE EXCISION

An interval of eleven months elapsed.

STAGE 4 MULTIPLE EXCISION

An interval of two years elapsed

STAGE 5 MULTIPLE EXCISION

The result of these procedures is presented in Figure 549 e

HEMANGIOMA

This pathological condition and management have been freely discussed previously (see p 234) The author has stated his conviction that any type of radiation, except as a preparatory step in the ultimate repair is not only bad cosmetically but, much more important it also defers or inhibits bone, cartilage and soft tissue development in the early formative years The management may be sclerosing chemicals in certain cases, but, in general proper surgery is the choice

It is apparent that no other procedure could be considered in the following case

Case I. A female infant, aged three and one half months, presented a hemangioma of the lower two thirds of the right forearm and hand. This involved two thirds of the circumference in the middle and three fourths of the circumference of the lower arm. It completely surrounded the wrist and the area 1 inch above it. It extended down to the knuckles on the dorsum and involved all the thenar eminence. A large part of the thumb was involved.

It was elected to excise the lesion, skingraft the defect, and finally replace this graft with bordering skin by multiple excision or an abdominal flap, if necessary The surgery was deferred until the child was six months old.

Procedure: STAGE 1 EXCISION OF THE HEMANGIOMA SKIN GRAFT A tourniquet was applied. The entire mass down to the wrist and a part on the dorsum of the hand were excised The tourniquet was removed and total hemostasis accomplished. The area was covered with split skin (0 010 inch) which was basted in position covered with xeroform gauze and waste and bandaged with moderate pressure.

An interval of three weeks elapsed.

STAGE 2. SKIN GRAFT Multiple areas of the graft—about 75 per cent—absorbed. A graft was applied and dressed as previously

An interval of fifteen months elapsed.

STAGE 3 MULTIPLE EXCISION The previous excision, ligations and graft resulted in considerable atrophic cicatrix on the dorsum of the hand, thumb, and so forth.

Procedure A V incision was made across the dorsum from the ulnar border and the skin on both sides of the incision was elevated and the maximum scar excised.

The condition three months and one year following the procedure is presented in Figure 550, c d



Fig. 550 Case I capillary and cavernous hemangioma ligation and excision of the lesion, skin graft of the defect and, finally replacement of the graft by multiple excision

ELEPHANTIASIS—CHRONIC LYMPHEDEMA

This is a chronic condition which may be congenital, or due to filariasis or increased lymph flow about varicose veins, or to a thrombophlebitis. It may, and not infrequently does result from gland dissection with resultant scar in the operation of a malignancy It is characterized by obstruction and inflammation of the lymphatic channels with hypertrophy of the skin and subcutaneous tissues

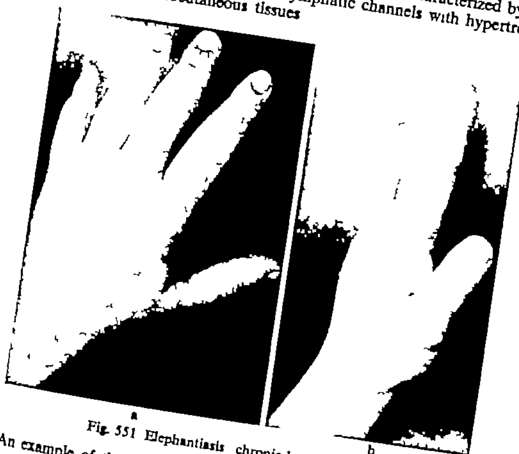


Fig. 551 Elephantiasis chronic lymphedema.

An example of the congenital condition is presented in the hand in Figure 473 *a* (p 699) This patient has asymmetry of the face due to this condition on the entire right side and the right posterior neck He also presents this condition in his left upper arm and the hand in Figure 551 *a b* He has a slight but definite hyperemia of the skin covering these areas

No surgical intervention in this area is indicated A biopsy presents mild chronic lymphangitis

CONGENITAL CONSTRICTION BANDS

These are congenital developmental anomalies that may occur anywhere on the body surface and, perhaps elsewhere. The author has had patients with such bands on the face running from the inner canthus on both sides around tho orbital margins to the lateral borders of the malar on the external ears on the arms forearms and fingers and on the legs and toes. Examples in several of these areas are presented The



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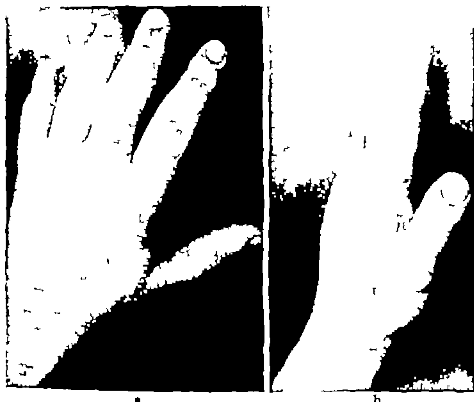


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contractions on the extremities have appeared to occur in the fascia, while that in the face had short, tight fascial bands with several small adhesions to the periosteum

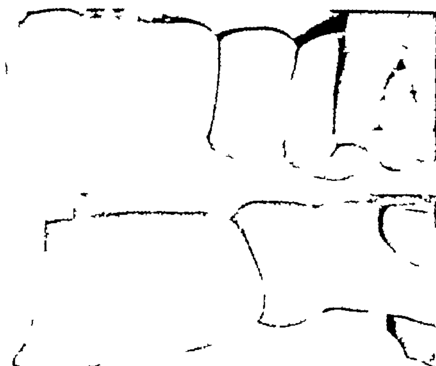


Fig. 552. Congenital constriction bands. (See text for detailed discussion and procedure.)

The management is obviously surgical. The procedure is discussed later with two cases on the leg (see pp. 827, 828)

CICATRICIAL CONTRACTION: BURNS, TRAUMA

The reparative cycle of fibrous tissue development has been discussed in relation to other body areas. The stage of full development is characterized by contraction, final slighter relaxation and some consequent degree of softening

The process always creates cosmetic and frequently varying degrees of functional disability. The latter is particularly true of its effect on flexor, tensor and other moving structures. Examples of this on both extremities are presented for discussion of several types of technical management which are of particular value here

Case I. A boy, aged five, presented marked burn scar contraction in the axilla, arm and elbow. He had been hospitalized for four and one half years before this examination. Split skin and "pinch" grafting had been done on several occasions. The upper half of the arm was firmly attached by thick scar to the chest wall which prevented any movement. The forearm was flexed by scar contraction and could be extended only 45 degrees. There was retarded development of the hand and atrophy from disuse. Hand function was normal. There were several granulating areas on the arm

Procedure STAGE 1 The ulcer areas were excised between elliptical incisions, the bordering scar was elevated for 3 or 4 cm. on either side, and the edges were approximated with 00000 Dermalon sutures.

An interval of two months elapsed.

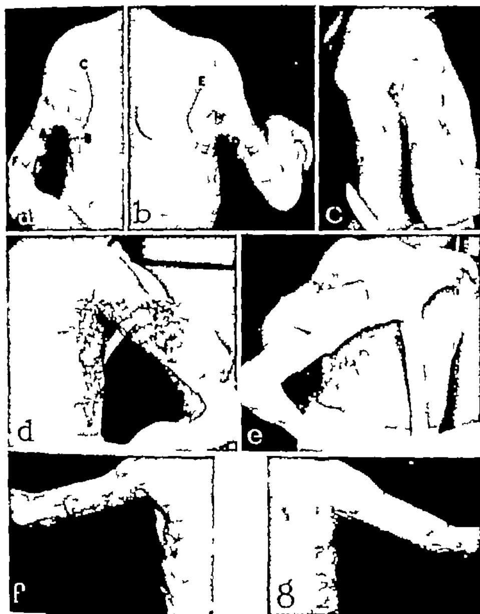


Fig. 553 Case I burn scar contraction in the axilla, arm and elbow ulceration. *a*, *b* and *c* The original condition and the outline of flaps for its correction *d* and *e* the result of the elevation and approximation of flaps *ABC* and *DE* and a Z plastic outlined in *F* on the elbow *f* and *g* the result of the procedure. (See p 802 for a discussion of detail and procedure.)

STAGE 2. ELEVATION AND TRANSFER OF FLAPS. An incision was made on the arm from the bottom of the chest adhesion, along the inferior border of this scar and mesially on the anterior chest to the top of the axilla, as seen in Figure 553 *a*, *b* *c* A similar incision was also made on the posterior thoracic wall (Fig. 553 *d* *e*) The flaps outlined were elevated, the arm was released, and the flaps were ap-



Fig. 554 Case II traumatic burn scar with loss of skin on the lower half of the arm, elbow and the upper third of the forearm, on the ulnar side: repair with an advanced, sliding arm flap and an axillary thoracic direct flap *a* and *b* The direct flap *c* the result of the procedure. (See p. 805 for detailed discussion and procedure.)

proximated on the arm. The axillary defect was closed by free elevation of the bordering skin, and advancement with moderate traction and anchorage by suture of the fascia to the axillary fascia with 00 plain catgut. The residual defect was grafted with split skin, 0.016 inch thick.

An antecubital Z plastic was performed to relax the heavy contracted scar band flexing the forearm (Fig. 553 *f*)

The arm was fixed with a plaster bandage on an airplane splint.

An interval of six months elapsed.

STAGE 3 Z PLASTIC ON SCAR CONTRACTURES. A Z plastic with arms 1¾ inches (4.5 cm.) released a scar contracture of the anterior axillary fold, and a second Z with arms 1¼ inches (3 cm) in the antecubital fossa further released the forearm

An interval of one year elapsed.

STAGE 4 Z PLASTICS ON SCAR CONTRACTURES. Moderate scar contractures in the anterior and posterior axillary folds were released by Z plastics.

An interval of fifteen months elapsed.

STAGE 5 Z PLASTIC ON ANTECUBITAL FOSSA. Z flaps with arms 2 inches (5 cm.) long were elevated from the fossa area the scar was dissected, and the flaps were transposed.

The result of these procedures is presented in Figure 553 *f g*

Case II. Traumatic and Burn Skin Loss of the Lower Half of the Arm Elbow and Upper Third of the Forearm on the Ulnar Side; Width of Loss 2½ Inches (6.5 cm.). Scar or defect in this area, too extensive for multiple excision or rotated flaps and in the presence of good axillary and chest skin covering, is well eliminated with direct anterior and/or posterior thoracic flaps or the use of small flaps from both areas (see Fig. 549 B p 798)

This patient, aged three years suffered burn and skin loss from a hot mangle two weeks before this examination. The olecranon process was exposed and the joint capsule lacerated.

Procedure STAGE 1 The upper half of the loss on the arm was covered by sliding the bordering skin to approximate, and suturing.

A flap 3½ by 7 inches (8.5 by 17.5 cm.) based on the posterior axillary fold was elevated from the axilla and anterior chest. The skin bordering the chest incision and the base of the flap was freely elevated, advanced with moderate traction, and approximated with mattress traction. Sutures of 00 Dermalon were made (see stitch scars in Fig. 554 *a b* p. 804)

The flap was approximated to the borders with 00000 Dermalon sutures and to the bed of the defect with 00000 plain catgut passed through the derma and exposed muscle.

The arm and dressing were fixed with a tensor bandage applied with moderate pressure.

An interval of five weeks elapsed.

STAGE 2. INCISION AND ADJUSTMENT OF THE FLAP BORDER. The flap was incised along its base and the resultant narrow flap adjusted on the arm.

The result of the procedure a month later is presented in Figure 554 *c*

Case III. Burn Scar Contracture of Arm Elbow and Forearm Limiting Extension of the Forearm. A girl, aged eleven, had been burned on the forearm, arm, shoulder and axilla at the age of fourteen months. She presented a dense scar with marked contraction beginning at the middle of the flexor surface of the arm, extending across the elbow joint and terminating on the midforearm. There was a 35 degree limitation of extension. The scars of previous surgery are seen around the shoulder (Fig. 555 *a* p. 806)

Procedure: STAGE 1 EXCISION OF THE DENSE SCAR. A Z type—staggered incision lines—of flaps with multiple excision is the plan of reconstruction.

Two Z type of flaps were outlined, one on the upper arm and one on the forearm. The entire contracted linear scar was excised along the line of the central member and the arms of these flaps were incised on either side from the borders of the excision. The flaps and bordering skin were freely elevated and the flaps transposed

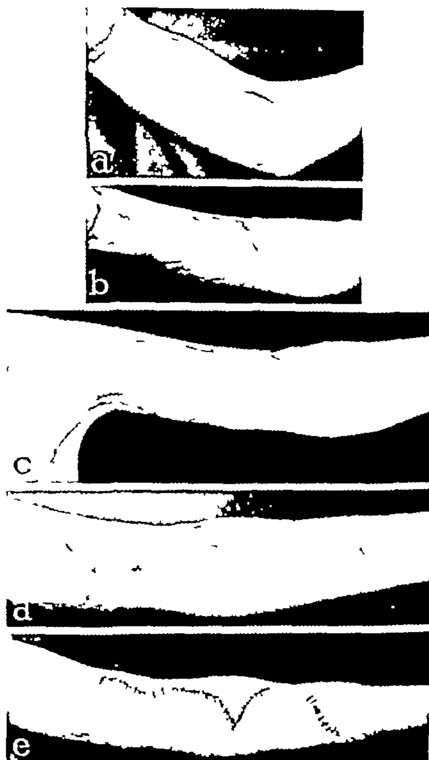


Fig. 555. Case III. burn scar contracture of the arm, elbow and forearm limiting extension of the forearm: multiple excision. (See p. 805 for detailed discussion and procedure.)

(Fig. 555 *b*) sutured with 00000 Dermalon, and dressed with moderate pressure and the arm in full extension.

An interval of four years elapsed.

STAGE 2. SCAR EXCISION ON THE UPPER ARM AND SHOULDER. This area was about 3 inches (7.5 cm.) in width. Z flaps, with the central arm along the border of the scar were incised and freely elevated. The flaps were transposed with moderate traction which permitted excision of about two thirds of the entire scar in this area. The result of this procedure is seen in Figure 555 *c*.

An interval of two years elapsed between Stages 2 and 3 and six months between Stages 3 and 4

Stages 3 and 4 were repetitions of the excision of scar The result of Stage 3 is presented in Figure 555 *d* and that of Stage 4 in Figure 555 *e*

Case IV Traumatic Loss on the Mesial Surface of the Elbow: Direct Abdominal Flap. An infant, aged nineteen months, lost a skin and fascial surface



Fig. 556. Case IV traumatic loss on the mesial surface of the elbow direct abdominal flap.

3 by 5 inches (7.5 by 12.5 cm.) from the mesial side of the elbow in a power wringer two weeks before this examination (Fig. 556 *a*) This was covered with a direct abdominal flap.

Procedure STAGE 1 A flap of adequate size was incised and elevated with little fat from the upper abdomen rotated 90 degrees, and approximated to the borders of the defect with 00000 Dermalon sutures. The abdominal defect was closed by elevation, sliding and approximation of the bordering skin.

An interval of three weeks elapsed.

STAGE 2. The flap base was incised with sufficient width of skin to adjust it in the border of the defect (Fig. 556 *b*)

Case V Burn Scar Contracture of Arm, Wrist and Hand. The patient, aged thirty four had been burned at the age of two years.

The traction band originated in the lower third of the arm and extended to the hypothenar eminence, the annular ligament and palmar fascia of the left hand. The band was elevated by contraction 1½ inches (3 7 cm.) above the surface of the forearm and had flexed and rotated the hand to the extreme limit. The fingers presented similar scar bands drawing them to extreme flexion. The fourth finger was displaced 75 degrees from its normal articulation. The finger joints were freely movable in this position (Fig. 557 *a*)

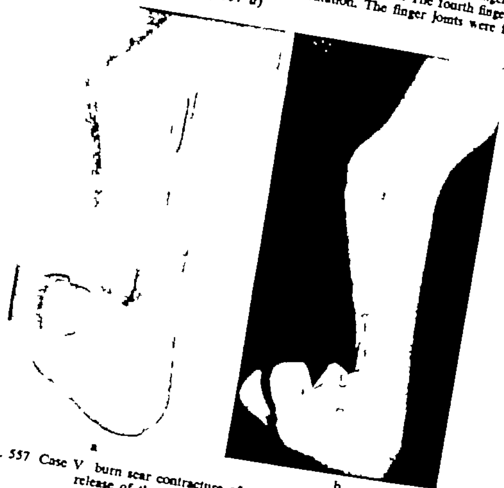


Fig. 557 Case V burn scar contracture of the arm, wrist and hand Z plastic release of the contracted scar band traction.

The patient was a mechanic. The hand and arm could be reconstructed to greatly improve its useful function.

The purpose of this procedure was completely to eliminate the scar band traction and permit the further stages of the plan of management.

Procedure Three Z flaps (1½ inches—3 7 cm.) with their central members splitting the scar band, were incised, elevated and transposed (Fig. 557 *b*)

A tubed pedicle abdominal flap of sufficient size to cover the wrist, palm and volar surface of the fingers was incised and its pedicle tubed.

It was found that the elbow joint was fixed in the position of extension presented in Figure 557 *b*

Case VI. Forearm—Wrist and Hand: Traumatic and Heat Loss; Direct Abdominal Flap. The patient, aged thirty two had caught his hand and forearm in a winding drum operating at a temperature of 400 F in a paper mill seven weeks before this examination (Fig. 558 *a*)

There was a volar loss of skin and subcutaneous tissue of 2⅜ inches by 4¾ inches (6 by 12 cm.) and a dorsal one of 1 by 1½ inches (2.5 by 3 7 cm.) The tendons of the palmaris longus and the flexor carpi radialis were exposed and included in a partially liquefying slough There was a partial sensory loss in the median distribution.

Procedure Two weeks were required to prepare the bed for repair

STAGE 1 A flap, with its base upward on the lateral chest, was outlined and incised across the upper quadrants. It was elevated with very little fat, rotated 90 degrees and sutured in the defect. The resultant abdominal defect and a small part of



Fig. 558 Case VI traumatic and heat loss of skin of the forearm, wrist and hand direct abdominal flap *a* The loss and the exposed palmaris longus and flexor carpi radialis tendons, *b* the direct abdominal flap *c* the result of the procedure *d* dorsal defect, and *e* its repair with a split skin graft. (See text for detailed discussion and procedure.)

the flap adjacent to the arm were grafted with split skin. The dorsal defect was similarly covered (Fig. 558 *b*)

An interval of five weeks elapsed.

STAGE 2. The flap was sectioned and adjusted to the balance of the defect (Fig. 558, *c*)

There was complete sensory return in a few weeks.

Case VII. Burn Scar Contraction Deformities of the Wrists and Hands. The patient, a female infant, aged two had suffered extensive burn of the face, mouth, thorax, abdomen and arms four months previously which healed and contracted before this examination The scar contracture deformities about the elbow and wrists were extreme in some respects. There was a 90 degree fixed flexion of the forearm and wrist, a dislocation and 180 degree flexion of the thumb, and marked flexion deformity of the fourth finger on the left side (Fig. 559 *a* p. 810)



Fig. 559 Case VII burn scar contraction deformities of the wrist and hands *a*. Ninety per cent fixed flexion of the forearm and wrist, a dislocation, and 180 degree flexion of the thumb and marked flexion deformity of the fourth finger on the left hand *b* *c* and *d* the result of the procedure.

There was marked flexion of the wrist, dislocation and flexion of the thumb, and 90 degree flexion and lateral dislocation of the index finger on the right side (Fig. 559 *e*)

Procedure Left side.

STAGE 1 The metacarpophalangeal joint of the thumb was completely dislocated. A thick scar band pulled and fixed the distal part of the thumb to the radial surface of the wrist. This was entirely released by a Z plastic which left a skin defect 2 inches by ¾ inch (5 by 2 cm.) that was split skingrafted. The contraction of the volar surface of the forearm and wrist, flexing and fixing the hand, was relaxed by a Z plastic. That flexing the forearm was released by a Z plastic which permitted full extension. A similar procedure partially released the fourth finger

The hand and arm were splinted and dressed in extension and the thumb in its normal position.

An interval of six weeks elapsed.

STAGE 2. CORRECTION OF SCAR CONTRACTION ON THE THUMB. This newly formed scar produced a moderate abduction and prevented proper adduction This scar was released with an added Z plastic.

An interval of six weeks elapsed.

STAGE 3 CORRECTION OF SCAR CONTRACTION PRODUCING MODERATE FLEXION OF THE HAND, AND TENDOPLASTY ON THE ABDUCTOR POLLICIS TENDON The wrist was incised around the scar at the base of the thumb to the midline. The dissection of scar relieved the flexion of the hand.

The abductor pollicis longus tendon was lengthened ¾ inch (2 cm) by the tendon splitting procedure and sutured with 0000 chromic catgut.

The skin defect on the dorsal and palmar surface was 2 by 1½ inches (5 by 3 7 cm.) This was covered by a direct flap raised on the right lateral thorax (see Fig. 559 *a*, *b* p 810)

An interval of three weeks elapsed.

STAGE 4 The flap pedicle was incised and adjusted.

An interval of ten weeks elapsed.

STAGE 5 CORRECTION OF A RESIDUAL FLEXOR DEFORMITY OF THE LITTLE FINGER RESULTING FROM A SCAR BAND RUNNING FROM THE PALMAR FASCIA TO THE MIDDLE PHALANX AND A RECURRING DEFECT IN THE LEFT WRIST SCAR SKIN COVERING WHICH PARTIALLY EXPOSED THE FLEXOR TENDON A Z plastic was performed on the scar band to the fourth finger and a skin tube 5 inches (12.5 cm.) long was formed from the best abdominal skin to replace, later the defective wrist area

An interval of six weeks elapsed.

STAGE 6 The defective area in the left wrist was excised, leaving a defect 1¾ inches by 1 inch (4.5 by 2.5 cm.) The lateral attachment of the tube was excised and sutured to the wrist defect. A plaster dressing fixed the arm to the body and abdomen.

An interval of one month elapsed.

STAGE 7 The tube was excised from the abdomen and attached to the ulnar surface of the forearm.

An interval of three weeks elapsed

STAGE 8. EXCISION OF SCAR ON THE RIGHT WRIST AND TRANSFER OF THE TUBE FLAP The scar on the dorsum, on the radial and volar surfaces of the wrist and about the base of the thumb was excised. This included the scar band displacing the index finger laterally (Fig. 559 *e* p 812)

The proximal (superior) end of the tube on the left forearm was excised, this end of the tube was opened flat to provide a proper covering flap, the forearms were folded over the lower abdomen with the wrists approximating, and the flap was sutured to the defect on the right wrist.

The arm and forearms were fixed with a plaster body cast and the hands and wrists stabilized with a tensor (Ace) bandage

An interval of five weeks elapsed.

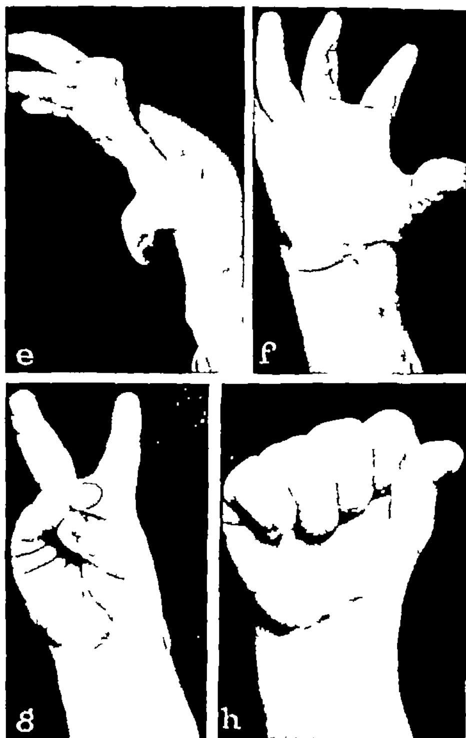


Fig. 559 (continued) *e* Marked flexion of the wrist, dislocation and flexion of the thumb 90 per cent flexion and lateral dislocation of the index finger of the right hand. *f* *g* and *h* The result of the procedure (See p. 811 for detailed discussion and procedure)

STAGE 9 INCISION AND ADJUSTMENT OF THE PEDICLE BETWEEN THE WRISTS (Fig. 559 *e*)

An interval of eight months elapsed.

STAGE 10 ELIMINATION OF A TRACTION SCAR FROM THE MIDPORTION OF THE LEFT FOREARM BELOW THE ELBOW TO THE BASE OF THE THUMB. Z flaps 1½ inches (3 7 cm.) with their central members splitting the traction scar were incised, elevated and transposed.

The result of these procedures is presented in Figure 559 *c, d g, h* The cosmetic result may be improved after many months by thinning and resuturing the wrist flaps.

HANDS AND FINGERS

It is desirable to repeat for the sake of emphasis, that the use of free grafts and pedicled flaps has no proper place in the reconstruction of an exposed surface, if the surgeon has a choice of procedure and is going to discharge his full obligation to the patient. In numerous dis abilities resulting from trauma burns, and so forth such a choice" is present, and the surgeon may plan his procedure to utilize the bordering normal skin

The type of disability which may be corrected only with the use of tissue from a distance permits choice of several procedures which are desirable and superior to some of those frequently used Examples of these will be presented in the following discussion

Case I. Multiple Excision and Z Plastic: Scar Webbing, Hypertrophy and Contraction. A female infant, aged three and one half had had a mangle burn at the age of two and one half years. There was a scar web which approximated the first and second fingers the length of the first phalanx, partial webbing of this area between the second and third fingers and a scar web running from the base of the third finger to the distal end of the first phalanx of the fourth finger There was con tracted scar and hypertrophied scar lines on the distal half of the dorsum of the hand.

Procedure· STAGE 1 Z flaps in the web between the first and second fingers and on the traction web between the third and fourth fingers (see Fig. 541 p. 789 for description of this procedure)

An interval of six months elapsed.

STAGE 2. The web between the second and third fingers was corrected as in Stage 1 About 75 per cent of the dorsal scar was removed by making a "myrtle leaf" incision beginning at the base of the fourth finger and terminating at the proximal end of the hypertrophied scar at the base of the index finger The border ing scar and normal skin were freely elevated, and the excess was excised and approximated under moderate tension.

An interval of six months elapsed.

STAGE 3 Two Z flaps were incised with the normal dorsal skin and scar approxi mation line as their central members. These flaps and the skin about the base of the normal flaps were freely elevated. The apex of the ulnar flap was advanced with moderate traction, toward the web between the second and third fingers. The bor ders of the transposed scar flap were excised the maximum amount permitting approximation without excess tension. The other normal triangular flap was advanced toward the scar web between the first and second fingers in the same manner

An interval of three months elapsed.

STAGE 4. FURTHER NORMAL SKIN ADVANCEMENT AND SCAR EXCISION The external scar border of the ulnar flap was incised to the base of the second finger and from this point down its mesial border An incision was made along both borders of the radial flap and carried into the web between the first and second fingers. These flaps

and the remaining scar flaps were freely elevated and the apex of the ulnar flap was advanced and sutured to the base of the second finger and the apex of the radial flap to the web between the first and second fingers. The remaining scar was excised and the flap borders were approximated with 00000 Dermalon (Fig. 560 c) An interval of one year elapsed.

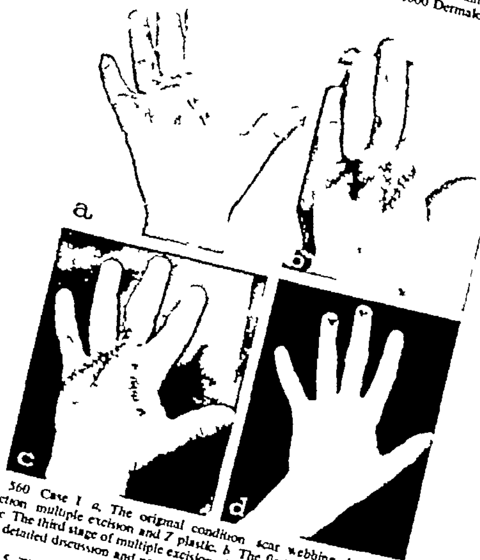


Fig. 560 Case I a. The original condition scar webbing, hypertrophy and contraction multiple excision and Z plastic. b The first stage of Z plastic and excision. c The third stage of multiple excision d The result of the procedure (See p 813 for detailed discussion and procedure.)

STAGE 5 The scars were excised their bordering skin was freely elevated, and approximation without tension was made with 00000 Dermalon. The result of the procedure one year later is presented in Figure 560 d.

Case II. Multiple Excision and Z Plastic: Contraction Scar Webs; Hypertrophied Scar on the Dorsum. A female infant, aged two and one half years, had suffered a severe pressure burn in an electric mangle one year previously.

There was hypertrophied contracted scar in the distal half of the dorsum of the left hand which began at the proximal phalanx of the first finger and extended downward and outward to the fourth finger a markedly contracted, hypertrophied scar from the base of the second finger running downward and radially to the base of the thumb a web between the proximal phalanges of the first and second fingers,

and smaller ones between the other fingers. The tendons and joints were normal (Fig. 561 *a*)

Procedure STAGE 1 The web between the first and second fingers was corrected with Z flaps (see Fig. 542 p. 790)



Fig. 561 Case II contraction scar webs. *a* Hypertrophied scar on the dorsum multiple excision and Z plastic. *b* Result of the first procedure. *c* The result of the third procedure. *d* The final result of the procedure. (See text for detailed discussion and procedure.)

An incision was made across the scar from the index to the fourth finger the dorsal scarred and normal tissue freely elevated and advanced with moderate traction, the excess scar flap excised, and the approximating borders sutured with 00000 Dermalon.



Fig. 56 Case III flame burn, flexor contractures Z plastic correction. *a*, The original condition *b* the Z plastic procedure *c* the final result of the procedure (See p 817 for detailed discussion and procedure)

An interval of ten weeks elapsed.

STAGE 2. EXCISION OF THE SCAR BAND FROM THE METACARPAL PHALANGEAL JOINT OF THE SECOND FINGER TO THE BASE OF THE THUMB Z PLASTIC ON THE WEB BETWEEN THE THIRD AND FOURTH FINGERS (Fig. 561 *b*)

An interval of three months elapsed.

STAGE 3 ADVANCEMENT OF THE NORMAL SKIN FLAP TOWARD THE BASE OF THE FIRST AND SECOND FINGERS; SCAR EXCISION (Fig. 561 *c*)

An interval of eighteen months elapsed.

STAGE 4 Scar contracture had produced a small web between the first and second fingers. This was corrected with a small Z plastic The result of these procedures is presented in Figure 561 *d*.

Case III. Flame Burn, Flexor Contractures. A girl, aged nineteen, had contractures from the middle phalanx of the thumb to the distal part of the palmar fascia and similar scar bands running from the middle phalanx of the first, second and third fingers to the palmar fascia. These contractures were released and normal function was restored by Z plastics performed under local anesthesia. The cosmetic result is superior to any accomplished by grafts or flaps.

Procedure STAGE 1 Z flaps with central and lateral arms ½ inch (1.3 cm.) long were incised with the central arms splitting the scar from the middle phalanx of the second finger to the thumb. The scar underlying these flaps was thoroughly excised and the flaps were transposed.

An interval of ten weeks elapsed

STAGE 2. The scar bands on the first and third fingers were released as in Stage 1 (see Fig. 562, *b*)

Figure 562, *c* presents the result of these procedures.

Case IV Direct Abdominal Flap; Burn Scar Contraction of the Palmar Fascia and Flexor Surfaces of the Fingers. A boy aged eleven years, had suffered a stove burn at the age of two years. He had no surgical care. The development of this hand had been retarded—it was a third smaller than the left one. There was dense scar originating in the proximal third of the palm which extended to the thumb and fingers at their midpoints. The main deformity involved the thumb and the second and fourth fingers (Fig. 563 *a b* p 818)

Procedure STAGE 1 Incision was made transversely across the distal palmar crease, and continued in a zigzag line along the web to the thumb, across the thenar eminence, transversely across the base of the palm and up the ulnar surface to the point of beginning. A Z plastic was performed on the index finger and one on the distal part of the flexor surface of the fourth finger The webs between all fingers were released by splitting them and suturing triangular flaps from the dorsum to the palmar skin. The contracture on the distal part of the thumb was released with a Z plastic. Residual defects were covered with split skingrafts 0 016 inch thick.

An interval of four months elapsed.

STAGE 2 A rectangular flap 2 by 4 inches (5 by 10 cm.) was incised on the left chest and abdomen near the midline The pedicle was directed upward and laterally and delayed.

An interval of one month elapsed

STAGE 3 A tourniquet was applied. The palmar graft was excised. The elevated flap was approximated and sutured to the hand. The small base of the flap was split skingrafted. The abdominal source of the flap was closed by sliding and approximating the bordering skin. The hand was dressed with the fingers in extension (Fig. 563 *c*)

An interval of five weeks elapsed.

STAGE 4 AMPUTATION OF THE FLAP AND ADJUSTMENT OF THIS BORDER.

An interval of six weeks elapsed.

STAGE 5 Z PLASTIC ALONG THE THENAR SCAR TO CORRECT CONTRACTION

An interval of five months elapsed.

STAGE 6. REVISION OF SCARS.

The result of these procedures is presented in Figure 563 *d e f*

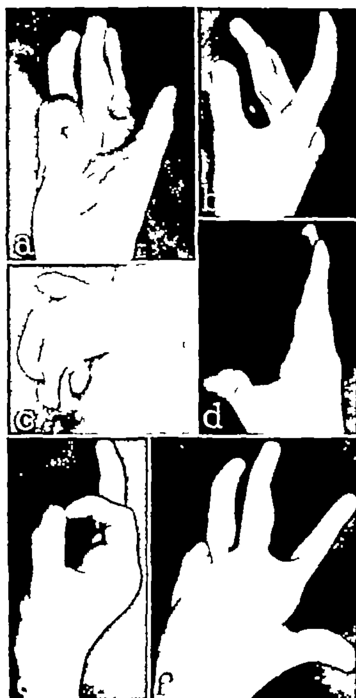


Fig 563 Case IV burn scar contraction of the palmar fascia and flexor surfaces of the fingers direct abdominal flap a and b The original condition c the direct abdominal flap d e and f The result of the procedure (See p 817 for detailed discussion.)

Trauma

Case V Split Skin Graft; Avulsion of Palmar Skin and Fascia. A man, aged twenty-six, had caught his hand in the rollers of a paper machine seventeen days before this examination with loss of skin covering and much of the fascia from

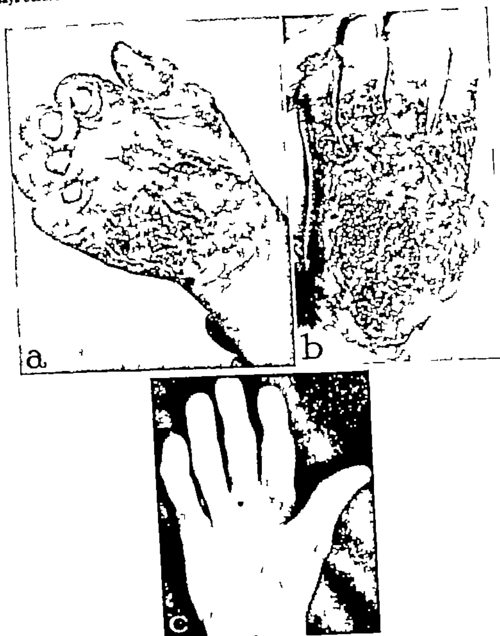


Fig. 564 Case V avulsion of palmar skin and fascia split skin graft. *a* and *b* The original condition *c* the result of the procedure. (See text for detailed discussion.)

the annular wrist ligament to the proximal phalanges of all four fingers. There was, also, skin loss on the dorsal thumb surface and skin tears of varying lengths on the lateral surfaces of the first and second fingers and the thumb There was no tendon involvement The fingers were fixed in flexion (Fig. 564 *a*)

Procedure: STAGE I DEBRIDEMENT MANIPULATION AND EXTENSION OF FINGERS,

PLASTER SPLINT TO HOLD THE FINGERS IN EXTENSION (Fig. 564 *b*) PEPTONE DRESSING.

An interval of eleven days elapsed

STAGE 2. Split skin 0 016 inch thick from the thigh was fixed with a running suture and a scarlet red dressing with moderate pressure.

An interval of two months elapsed.

STAGE 3 Z PLASTIC CORRECTION OF A CONTRACTED SCAR BAND ON THE FIFTH FINGER.

An interval of six months elapsed between Stages 3 and 4 and two weeks between Stages 4 and 5

STAGES 4 AND 5 *Z PLASTIC CORRECTION* (Fig. 541 *p* 789) *OF THE SCAR WEBS* BETWEEN THE SECOND AND THIRD AND THIRD AND FOURTH FINGERS. The result of these procedures is presented in Figure 564 c.

Case VI Split Skin Graft; Mangle Burn of the Palm and Flexor Surface of the Fingers. A female child, aged three, burned her hand in a gas mangle one week

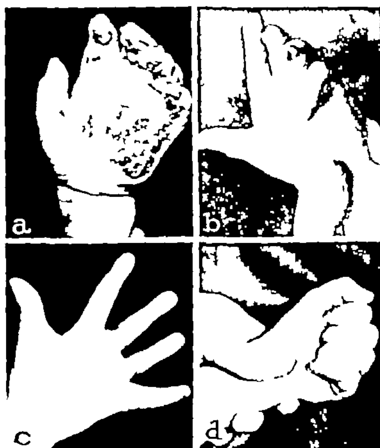


Fig. 565 Case VI mangle burn of the palm and flexor surface of the fingers split skin graft.

before this examination. There was loss of skin and fascia over the entire palm along a line from the proximal phalanx of the thumb across it to the annular ligament on the ulnar side and distally to the midphalanx of the fingers. This surface was covered with typical necrotic slough (Fig. 565 *a*)

Procedure This was similar to the management of Case V

STAGE 1 DÉBRIDEMENT: NO TENDON EXPOSURE The hand was fixed in 30 degree

dorsal flexion with the fingers extended on a metal splint A petrolatum pressure dressing was applied.

An interval of two weeks elapsed.

STAGE 2. Split skin 0.016 inch thick was basted in place and approximated with a moderate pressure dressing.

The condition of this hand one month later is presented in Figure 565 *b* The degree of flexion in the second, third and fourth fingers due to scar contraction indicated that the use of a *flap* would have been *better judgment than* the choice of the *free* split *graft* Physiotherapy with both passive and active exercise, prevented what appeared to be an unfortunate outcome The result is presented in Figure 565 c.

This was a borderline condition in which the more certain choice of procedure should have prevailed.

Case VII. Direct Flap Covering: Steam Burn and Trauma of Dorsum and Fingers of the Hand. A woman aged sixty-one caught her right hand in a steam clothing press which became locked and could not be opened for several minutes. The loss resulted from both heat and pressure

There was a third degree burn over the entire dorsum from about 1½ inches (3 75 cm.) proximal to the wrist joint to the distal phalanges of the first, second and third fingers. The lateral burned area extended to the base of the thumb and fourth finger (Fig. 566, *a, b* p 822)

There was limitation of flexor movement, but none of extension.

Procedure: STAGE 1 The hand was dressed on a splint with petrolatum, sulfathiazole powder and moderate pressure.

An interval of one month elapsed

STAGE 2. DÉBRIDEMENT PRESSURE DRESSING The extensor tendon sheaths were exposed and found damaged, but there was no limitation of tendon movement.

An interval of six days elapsed.

STAGE 3 PREPARATION AND TRANSFER OF A DIRECT ABDOMINAL FLAP A flap 7 by 8 inches (17.5 by 20 cm.) was incised and elevated on the left lateral thoracic and abdominal wall with its base superiorly The anterior border extended mesially at an angle of 45 degrees from the anterior axillary fold, and the opposite border began at the posterior axillary fold and ran parallel to the former The distal part of the flap—the hand covering—consisted of skin, superficial fascia and about 0.5 cm. of fat.

The donor area was closed by free separation and sliding of the bordering skin and fascia. The flap was approximated and sutured to the hand with 00000 Dermalon The arm and forearm were supported and fixed with a plaster dressing.

An interval of one month elapsed.

STAGE 4 The pedicle was amputated. A granulating area on the arm about the proximal margin of the flap was covered with split skin (Fig. 566, *c*)

The result of the procedure is presented in Figure 566 *d e f*

There is 100 per cent function of the thumb, 50 per cent flexion of the index finger and 75 per cent normal movement in all joints of the second and third fingers and 90 per cent in the fourth finger The patient is able to do all types of her work in the laundry

Case VIII. Split Skin Graft and Abdominal Skin Tube; Avulsion of the Skin of the Palm Dorsum, Fingers and Lower Forearm. A boy aged thirteen, caught his right hand and lower forearm in a corn shredder Each finger and thumb was amputated at the first interphalangeal joint. There was total avulsion of the skin, with exposure of tendons, from the fingers, hand, wrist and lower arm to a line 4 inches (10 cm.) above the wrist joint on the dorsal surface and 2 inches (5 cm.) above this joint on the volar surface (Fig. 567 *a, b* p. 823)

There was normal movement of the finger stumps and the wrist.

Procedure: STAGE 1 Split skin (0.014 inch thick) grafts were placed over the entire area and dressed in the usual manner

An interval of one month elapsed

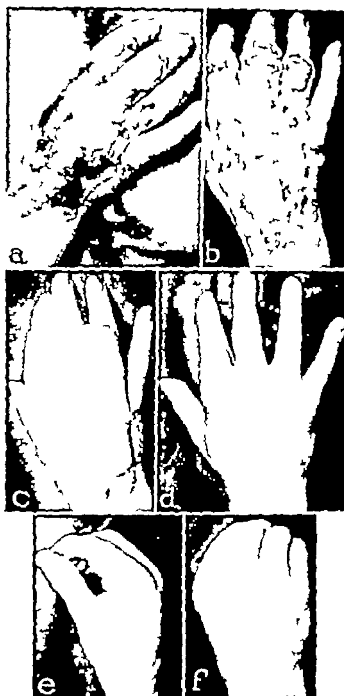


Fig. 566 Case VII steam burn and trauma of the dorsum and fingers of the hand direct abdominal flap. *a* and *b* The original condition *c* the result of the procedure *d* *e* and *f* result of the procedure

STAGE 2. SPLIT SKIN GRAFT ON AN AREA OF LOSS ON THE FLEXOR SURFACE OF THE WRIST The result of this grafting is presented in Figure 567 *c*, *d*

The split skin covering the end and body of the finger stumps was neither adequate functionally nor desirable cosmetically Full thickness skin with an adequate pad

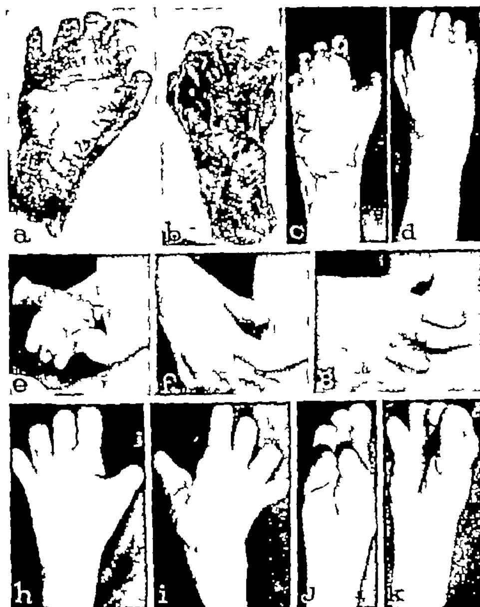


Fig. 567 Case VIII avulsion of skin of the palm, dorsum fingers and lower forearm split skin graft and abdominal skin tube. *a* and *b* The original condition *c* and *d* the result of the skin grafting, *e f g* the application of the abdominal tube to the fingers *h, i j k* the finished result of the procedure. (See p 821 for detailed discussion and procedure.)

to prevent injury and so forth is essential to useful function, particularly in this patient, who must participate in the many types of farm labor

An interval of four months elapsed

STAGE 3 CONSTRUCTION OF A TRANSABDOMINAL TUBE 4½ BY 7 INCHES (12 BY 17.5 CM) CORRECTION OF A FLEXION CONTRACTURE OF THE FOURTH FINGER WITH A Z PLASTIC ON THE PALM AND A WEB BETWEEN THE THUMB AND FIRST FINGER.

An interval of three weeks elapsed.

STAGE 4 TRANSFER OF THE SKIN TUBE TO THE THUMB The skin graft was removed from the entire thumb and the tube sutured in place with 00000 Dermalon. The arm was fixed with a plaster dressing.

An interval of three weeks elapsed.

STAGE 5 The tube was amputated from the thumb and fixed to the fourth finger (Fig. 567 *e* p 823)

An interval of three weeks elapsed.

STAGE 6. The tube was amputated and approximated on the first finger (Fig. 567 *f*)

An interval of one month elapsed.

STAGE 7 The tube was amputated and attached to the second finger with adjustment of the skin on the thumb and fourth finger (Fig. 567 *g*)

An interval of three weeks elapsed.

STAGE 8. AMPUTATION OF THE TUBE FROM THE SECOND FINGER. The third finger was placed under a pocket of abdominal skin. Adjustment of the skin on the index finger

An interval of three weeks elapsed.

STAGE 9 AMPUTATION OF THE ABDOMINAL SKIN ATTACHED TO THE THIRD FINGER AND ITS APPLICATION TO THE VOLAR SURFACE OF THIS FINGER.

An interval of two weeks elapsed.

STAGE 10 ADJUSTMENT OF THE SKIN ON ALL THE FINGERS.

The result of these procedures is presented in Figure 567 *h i j k*.

Malignancy

The malignancies occurring in this area demand the same radical management as elsewhere in the body Carcinoma appears with mod

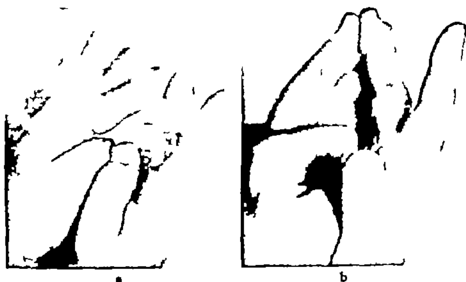


Fig. 568 Old x radiation burns on the second finger of each hand hyperkeratosis on the left finger squamous cell carcinoma on the right.

erate frequency in old burns with marked sclerosis and recurring ulcers in cases of dermatitis which have been treated by x-radiation and its reaction confused with the original dermatitis in older dentists who held film in position with their fingers and worked with tubes which produced diffused radiation, and so on and so forth

The sclerosis and obliteration of the lymphatics in these cases result frequently in marked local invasion and late metastasis The management consists in wide excision or amputation with plastic repair An example of the simpler situation is presented in the following case

Case I. This patient, aged forty three, was a dentist who for many years handled his dental films as noted above. He presented areas on the second finger of each hand which appeared premalignant or actually so (Fig. 568 a)

These areas were widely excised and grafted with split skin (0 014 inch thick) (Fig. 568 b)

The microscopic finding on the tissue from the left finger was hyperkeratosis with no malignant degeneration, on that from the right finger squamous cell carcinoma, grade II.

THIGH, LEG AND FOOT

Syndactylism and Polydactylism of the Toes

This condition was discussed in detail and methods of its surgical management were presented previously in consideration of exactly the same congenital malformation of the fingers (see pp 787, 791)

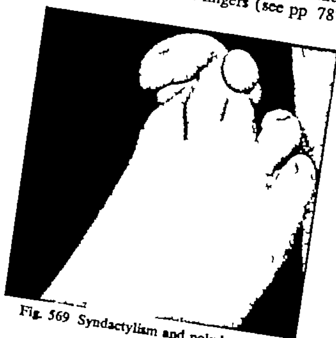


Fig. 569 Syndactylism and polydactylism.

An example of one such maldevelopment of the toes is presented in the following case

Case I. A girl, aged five, had underdeveloped fingers with constriction bands and the toe formation presented in Figure 569 There was excessive soft tissue enlargement of the first toe and bulbous distal ends on the second and third toes, which were fused. The terminal phalanx of the third toe was absent.

Flaps were elevated on the plantar surface of the bulbous ends the fibrous tissue mass containing bits of cartilage was excised to the distal end of the proximal phalanx of the first toe the fusion of the distal phalanges of the second and third

toes was incised and the flap reflected and incised to make a zigzag approximation, and sutured with 00000 Dermalon.

Congenital Constriction Bands

The nature and distribution of these congenital anomalies was discussed on page 801 in presenting a case with such bands on the fore arm and wrist

CASE I. A female child, aged three, had a constriction band around the middle

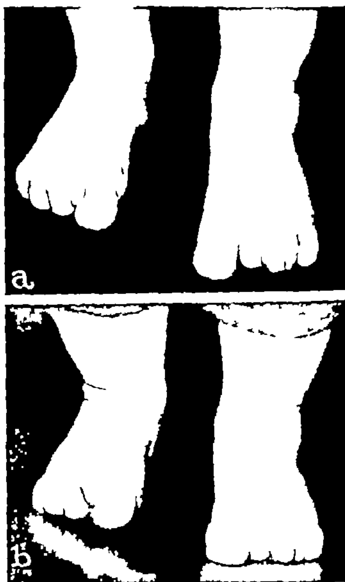


Fig. 570 Case I congenital constriction bands. *a* The initial condition There is a constriction band on the big toe which was corrected by a Z plastic and a short first toe with a nail on the right side; constriction band on the big toe and third toe on the left side which were corrected with Z plastics. *b* The final result of this procedure

of the proximal phalanx of the first toe of the right foot and a maldevelopment of the second toe. There was a similar band around the first and third toes of the left foot (Fig. 570 *a*)

These fascial constriction rings relaxed with Z plastics on the dorsal surfaces.

The result is presented in Figure 570 *b*

Case II. Z Plastic of the Entire Circumference of Constriction Band Around the Leg. *A male infant, aged three weeks, presented a double cleft lip and palate* with the premaxilla markedly anterior to its normal position maldevelopment and syndactylism of the fingers and an amniotic band around the left leg.

Procedure *At the age of six weeks, Z flaps, with their central member splitting* the constriction band around the entire circumference were incised, elevated

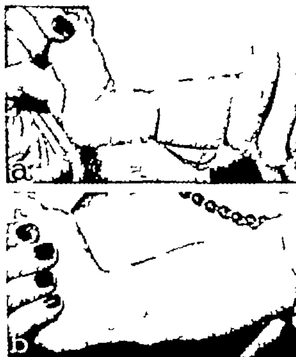


Fig. 571 Case II constriction band around the circumference of the lower leg Z plastic. *a*, The original condition *b* the result of the procedure (See text for detailed discussion.)

transposed and sutured with 00000 nylon The result is presented in Figure 571 *b* Note the lymphedema of the foot and ankle.

This *procedure is a surgical mistake* because of the complete section of the superficial lymphatics. The lymphedema still persists after several years and will probably continue unless the skin is excised and replaced with thick split graft.

Case III. Z Plastic of a Congenital Constriction Band Around the Leg A female infant, aged two months, had syndactylism and constriction bands of the fingers *and similar* bands *on the leg and toes. The band on the leg decreased its* diameter one third.

Procedure The previous experience with Case II some years ago prevented a repetition of that poor judgment.

The arms of the Z were made long ($1^{3}/_{4}$ inches—4.5 cm. in this case) and placed on the external and internal surfaces of the leg. Each of these plastics relaxed the scar band 1 inch (2.5 cm.)

The lymph circulation of the foot and ankle remain normal after five years, as presented in the immediate result in Figure 572, *b*

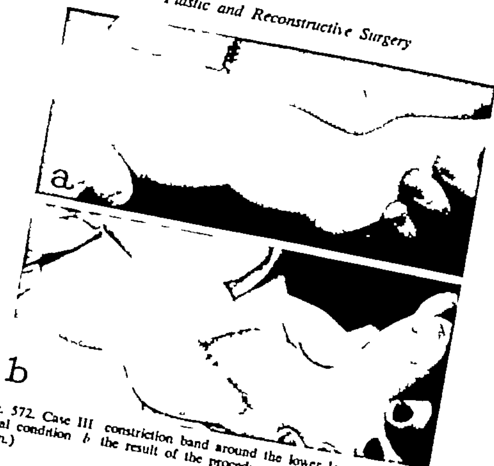


Fig. 572. Case III constriction band around the lower leg Z plastic. *a*, The original condition *b* the result of the procedure (See p. 827 for detailed discussion.)

Hemangioma

This congenital disability has been discussed in detail (see p 234) and its management described on pages 340 and 653 Some observers believe that a majority of these lesions regress spontaneously but this has not been the author's experience with a considerable number of cases. He believes on the contrary that those lesions which fail to show definite regression in eight to ten weeks should be treated with 5 per cent sodium morrhuate or surgically as indicated

The following case presented a formidable condition which had completely regressed without interference

Case I. A female infant who was examined shortly after delivery presented a large fluctuant swelling beginning at the lower third of the patella and extending laterally and mesially to the limit of these areas and distally for 3 inches (7.5 cm.) (Fig. 573 *a b* p 829) The skin surface was covered with dilated capillaries. The diagnosis was capillary and cavernous hemangioma superficial to the fascia.

After an interval of two months the fluctuant mass had gradually diminished in size and the dilated skin capillaries disappeared. The skin surface was thick, scaly and pigmented.

The fluctuant area was 1¼ inches (3.1 cm.) in width and extended distally from the patella 2 inches (5 cm.)

After an interval of four months from birth no fluctuation was present. The skin was moderately thickened, scaly and pigmented (see Fig. 573 *c d*)

After a further interval of seven months there was skin atrophy just below the



Fig. 573 Case I hemangioma. *a* and *b* The condition at the time of birth. The fluctuant mass extended from the lower patellar border down the leg for three inches (7¼ cm.) *c* and *d* The condition at the end of two months without interference. *e* and *f* The condition at the end of 7 months without interference. Examination at the end of 18 months presented a skin lying at a lower level than the normal borders. The circumference of both legs was equal. (See p. 828 for detailed discussion.)

patella. There was apparently atrophy of subcutaneous fat in this area. The circumference of the right leg in this area was 6½ inches (16.25 cm.) and of the left, 6¼ inches (15.5 cm.) This condition is presented in Figure 573 *e*, *f*.

At the age of eighteen months the skin of the involved area lay at a lower level than the normal borders. The circumference of both legs was equal. The skin pigment was regressing.

Cicatricial Contraction

Case I. A boy, aged seven years, had been burned two and a half years before this examination. He presented an unhealed area extending from the iliac crest to the inferior borders of the popliteal space in the right lateral thigh (Fig.

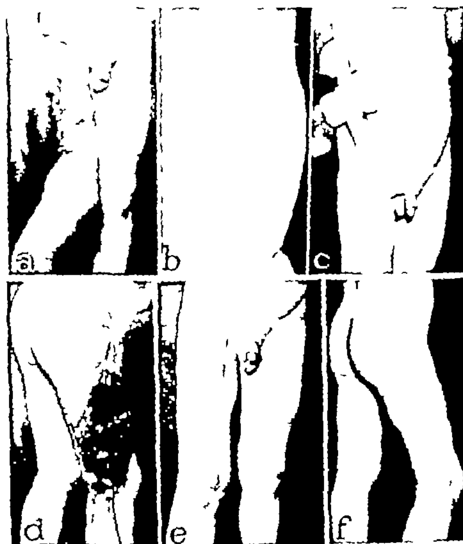


Fig. 574. Case I: granulating burn scar of 2½ years duration; unhealed burn of the right lateral thigh; marked inguinal scar; limited extension of the thigh and flexion of the leg. *a* and *d*: The initial condition. *c*, *e* and *f*: the granulating areas covered with split skin graft. *b*: the outline of a thoraco-epigastric vein. *c*: thoraco-epigastric tube. *e* and *f*: a thoraco-epigastric tube flap in the inguinal area; the final limitation of extension of the thigh and flexion of the leg. (See text for detailed discussion.)

574 a, e) and a dense inguinal scar he had limited extension of the thigh and flexion of the leg.

Procedure Split skingrafting of the entire granulating area did not eliminate the scar about the inguinal area or improve the extension of the thigh. A thoraco-epigastric tube was prepared (Fig. 574 b c) The finished result is presented in Figure 574 d f

The initial and final conditions are presented in Figure 574 e f

Lymphedema

This condition may be congenital or acquired by trauma or as a result of surgery



Fig. 575 Foot and leg 2 years after Owens procedure. Note the absence of any suggestion of edema in the foot and ankle. (See p. 833 for discussion)

The congenital condition probably results from developmental defects in the channels or glands. It is frequently circumscribed in a local area and may occur on any body surface It more frequently involves the lower extremity A circumscribed involvement of the posterior neck has been presented (p 699) in a patient having similar local areas on one cheek and on the leg. Such a local area on the hand is presented on page 801 This patient also had such an area on the leg. Several cases involving the lower half of the nose have been observed.

The lesion occasioned by trauma disrupts the channels in the skin and subcutaneous tissue and seals this area with fibrous tissue. Lesions following surgery may result from section of the skin and subcutaneous channels (see Fig 571 p 827) or from dissection and subsequent scar formation of terminal lymph nodes such as the inguinals, femorals, and so forth An example of the former is presented in the following case (Fig 578 p 835)

It seems certain that the initial pathological state occurs in the skin channels the subcutaneous channels to the level of the deep fascia and the main trunk into which they drain There appears to be no anastomosis with the deep lymphatics.

The initial edema is intercellular and soft This type is relieved by elevation and rest. If the condition persists, it is followed by a hard pitting edema and a slowly progressing sclerosis about the channels and in the surrounding connective tissue

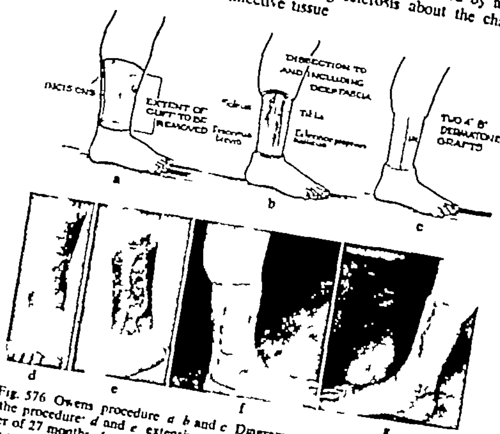


Fig. 576 Owens procedure *a b* and *c* Diagrammatic illustrations of the extent of the procedure: *d* and *e* extensive ulceration and scar associated with varicose ulcer of 27 months duration *f* and *g* the extensive excision and status of the graft 1½ years after operation.

Those operative procedures furnishing a bridge of skin and subcutaneous tissue with normal lymph channels from the pathological to a normal functioning area may be of service during the early part of this stage before marked sclerosis has occurred but not later

The terminal stage of the process is characterized by marked sclerosis with blocked or obliterated lymph channels and tense skin covering

Methods of treatment have evolved during the past fifty years and have recently become effective with a better understanding of the pathological and anatomical problem.

Handley suggested capillary setons of braided silk which were of service in relieving the frequent marked simple edemas that occurred in lower lids after trauma and so on in World War I They are of no

practical service in the types under discussion Noncapillary setons to form a draining channel were later suggested

Later surgical procedures were intended to anastomose the super ficial channels with those under the deep fascia. These had little success

Gillies and Fraser reported the use of a skin-connective tissue lym phatic channel bridge from the pathologic to a normal draining area with success in some cases

Owens described in 1937 the basis of the present conception and plan of management and reported several excellent results The experience of the subsequent years has modified his procedure to shorten the time required and complete it in one stage Owens and Bethea recently reported an added group of excellent results by this method.

Macey in 1940 described a plan utilizing part of the Owens technic. Bunnell later reported a similar management for the upper extremity, and, recently Blocker has presented a group of excellent results in which he utilizes part of this procedure

The latter group of procedures differs from Owens in one particular which is based on the accepted belief that a collateral or anastomosing lymph flow from the superficial to the deep channels cannot occur Hence, they terminate the excision at the plane of the deep fascia. Blocker relieves the residual edema of the foot by similar excision on the dorsum of the foot and toes with subsequent grafting

Owens, on the contrary *maintains that lymph drainage into the deep channels does occur* He described and practices excision of the deep fascia to obtain a better blood supply for the grafted area and this collateral lymph drainage. His considerable group of cases from various occupations such as boilermakers, farmers, and others who spend much of their working time standing, and none of whom have had evidence of edema of the foot and so forth, is sufficient proof of the correctness of his technic.

This is another example of the not infrequent acceptance of assumptions and dicta of academic investigations which do not agree with the clinical observations of the careful observer The author was one of the many believers in the accepted descriptions of the lymphatic channels of the extremities It was not until Owens provided him with indisput able clinical proof that he accepted the facts. This entire matter is of such clinical importance that he devotes space to this discussion

Note the feet in the case presenting Owens deep fascial excision and Blocker s procedure with skin grafting of this area (Figs 575, 576 577)

Owens has provided the author with some excellent kodachrome films of this foot made one year later than those in his report—two years after surgery The feet are perfectly normal (Fig. 575)

Mowlem has recently reported a two-stage method of excision of the skin and subcutaneous involved tissue down to the deep fascia and subsequent grafting two weeks later when the deep fascial bed is dry and granulating.

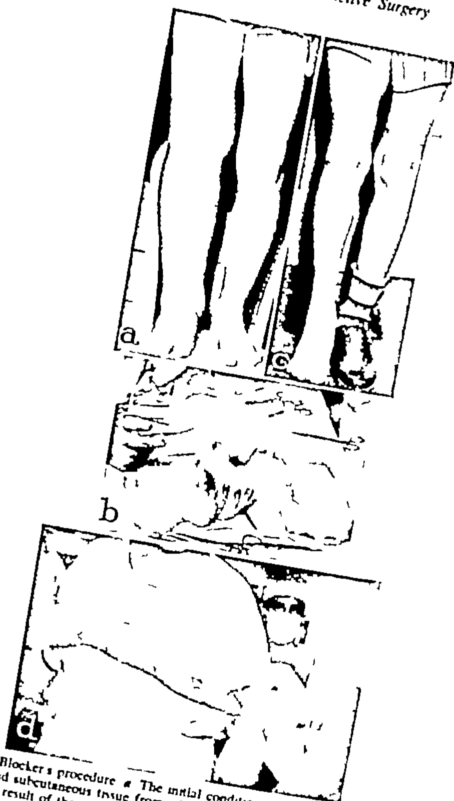


Fig 577 Blocker's procedure *a* The initial condition of the patient *b* the excised skin and subcutaneous tissue from which the grafts are split *c* the applied grafts *d* the result of the procedure (See p 831 for detailed discussion)

Blocker recently reported an excellent group of cases in which the entire involved tissue of the leg down to the foot was excised the re

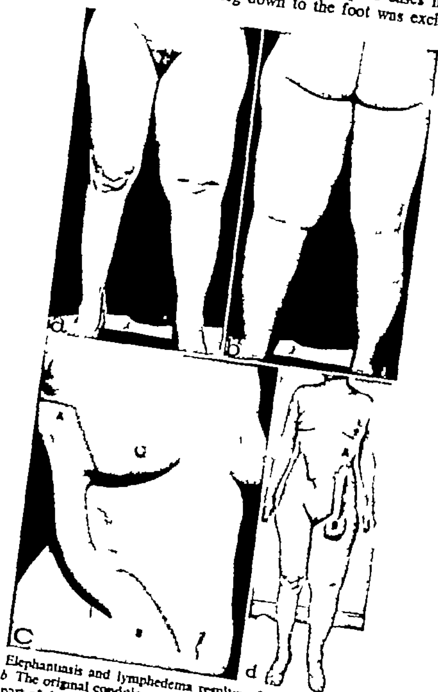


Fig. 578 Elephantiasis and lymphedema resulting from extensive inguinal surgery *a* and *b* The original condition *c* presents a right thoraco-epigastric tube *d* the superior part of the tube, *A* transferred to the left inferior axillary area and the inferior end, *B* transplanted in the thigh below the inguinal canal. (See p. 836 for detailed discussion)

moved skin split with the dermatome to furnish the graft covering, the involved skin excised from the foot except from the toes and plantar surface and this area split skingrafted.

The author feels that these excisions should continue as near to the inguinal canal as a tourniquet will permit and that both thigh and leg should be operated on in a single procedure the patient's condition permitting. A second smaller excision will be required to clear the inguinal region

Blocker has excised the skin and subcutaneous tissue in the lower half of the thigh in the following case with good result. His method of splitting the graft from the excised skin makes these extensive excisions possible (Fig. 577)

The following case is presented to emphasize some of the considerations that were stated above and to discuss the several points essential to permitting the desired lymph flow through a skin-subcutaneous tissue lymph channel bridge flap

Case I The patient had a marked lymphedema of the thigh leg and foot of many months duration as the result of pelvic surgery and the drainage of numerous inguinal lymph nodes with scar formation (Fig. 578 *a, b* p. 835)

The plan of procedure was based on the knowledge that the superficial lymphatics of the extremity flow through the inguinal nodes; that the flow on the abdomen below the umbilicus is to these same nodes and that above the level of the umbilicus is to the axillary nodes; further that the inguinal nodes have been destroyed by drainage and scar formation A useful flap must be of adequate size, must consist of skin subcutaneous tissue and the deep fascia to insure functioning lymph channels, and must be placed in the direction of its normal lymph flow from the thigh below the inguinal line to this same tissue in the axillary area above the umbilicus.

A thoraco-epigastric tube flap 12 inches (30 cm.) long and 4 inches (10 cm.) wide was constructed on the right side (Fig. 578 *c* p. 835) Four months later the proximal end (*A*) of the flap was transplanted on the deep fascia of the left thorax above the umbilical line (Fig. 578 *d*) Three months later the distal end (*B*) was transplanted on the deep fascia of the thigh (Fig. 578 *d*)

It was planned to open the tube and transplant the length of the flap on the fascia if the bridged tube materially reduced the edema in the thigh. There was softening and relaxation for two months, and then the original condition returned. The flap *B* was excised, considerable scar removed from the deep fascia, and the flap returned. There was no further change in the condition of the thigh. Fibrosis ultimately changed the flap *B* into a dense hard mass.

It is evident that this procedure was followed too late in the development of the lymphedema. The degree of sclerosis was too great for lymph flow. The only useful procedure at this stage is complete excision and split skingrafting. The procedure described by Owens and recently by Blocker completed on both the thigh and the leg should produce a desired result.

Trauma; Recent Burns; Avulsion

Loss of surface covering—skin—should be replaced by one of several methods at the earliest possible time following the trauma Reasons for this and the technical requirements for its accomplishment have been discussed under General Considerations

Various indications and methods of desirable accomplishment are presented in the following cases

Case I is presented to emphasize again that the Reverdin ("pinch") grafts have no proper place in desirable reconstruction They neither prevent much scar formation nor control its contraction The cosmetic

result on both the donor and recipient areas is undesirable. The method enjoys no favorable comparison in any respect with the several methods of obtaining and utilizing split and whole skin

Case I. A man, aged thirty suffered a gasoline burn nine months before this examination. The burn surfaces were "pinch" grafted on two occasions three



Fig. 579 Case I Reverdin ("pinch") grafted burn scar (See text for detailed discussion.)

months after the trauma. Approximately 1000 such grafts were applied. The result is presented in Figure 579 There is marked, thick scar contraction with ulceration in both popliteal spaces, and contraction, which limits flexion about both knee joints.

The scar was excised from both popliteal spaces, and the areas were covered with

split skin 0.016 inch thick. This relaxation allowed 100 degrees of flexion of the right and 170 degrees of flexion of the left legs.

Case II. Split Skin Graft; Thigh and Leg Flame Burn. A youth, aged sixteen, suffered a third degree flame burn of the thigh and leg ten days before the condition presented in Figure 580 *a*.

Split skin 0.014 inch thick was taken from the abdomen and applied and dressed in the usual manner (see General Considerations p. 19) (Fig. 580 *b*).



Fig. 580. Case II. thigh and leg flame burn split skin graft. *a* The initial condition, *b* the applied graft, *c* the result of this procedure. (See text for detailed discussion.)



Fig 581 Case III fire burn split skin graft. *a* and *b* The condition of the patient 2 months after the burn and after the application of Reverdin grafts taken from the abdomen *c* and *d* the result of proper management and split skin grafting 3 months later (See p. 840 for detailed discussion and procedure.)

The leg was entirely healed with good function in six weeks. The result is presented in Figure 580 *c*.

Case III. Split Skin Graft; Fire Burn. A boy aged seven, was burned in a grass fire two months before this examination. The trauma involved the entire left buttock and a large part of the left lower extremity.

"Pinch" grafts had been taken from the abdomen, the lower back, the right thigh and leg (Fig. 581 *a b*). Many of these areas were granulating. There were decubitus ulcers. There was internal rotation of both extremities and flexion deformities of both knees.

Procedure: STAGE 1. Split skin 0.014 inch thick from the upper back was applied to the left buttock and thigh. Small pieces from the right buttock were applied as patches on the left leg and right thigh. The usual pressure dressing was applied.

An interval of eight days elapsed.

STAGE 2. Two drums of skin from the anterior thorax were divided into appropriate pieces and applied about the left knee and on the thigh.

An interval of three months elapsed.

STAGE 3. The scar in the left popliteal space was completely excised. This involved the tendon sheaths. Split skin 0.014 inch thick from the back was applied and dressed. The maximum extension at this time was about 165 degrees. The leg was immobilized in a plaster dressing.

The result of this procedure and physiotherapy is presented in Figure 581 *c d*.

Case IV. Small Split Grafts; Old Burn. A boy aged six, had suffered a third degree burn of the entire abdomen, lateral right thigh and leg. He had been



Fig. 58_. Case IV. unhealed third degree burn of long duration small split skin grafts. *c*. The final result of this procedure. (See text for detailed discussion and procedure.)

hospitalized for many months before this examination. The condition at this time is presented in Figure 582, *a*.

The granulating area on the left thigh was the donor site for the graft seen over the right popliteal space. There were numerous granulating areas of various size between areas of organized scar resulting from weeks of dressing.

The patient's history and condition determined the retention of the scar areas whose contraction could not disturb function and the application of small strips and pieces of split skin to the granulating areas. These were taken from the anterior thorax and the right thigh and were applied with salme pressure dressings on two occasions at an interval of one week.

These grafted areas are seen in Figure 58_, *b* and the result in Figure 58_ *c*.

Case V Tube Flap on a Carrier; Avulsion of the Leg. A girl aged eight, had suffered an avulsion of the left leg in an automobile accident twenty-six months



Fig. 583 Case V avulsion of the leg; tubed flap on a carrier *a*, The original defect *b* the abdominal tube on the wrist and hand as a carrier *d* the flap approximated to the defect *c* the result of the procedure. (See text for detailed discussion and procedure.) This is the transabdominal tube presented in Figure 521 (p. 766)

before this examination. She had had expert orthopedic care and was later skin grafted by another surgeon. There was complete loss of soft structure from the

lateral edge of the tibia mesially 2½ inches (6.25 cm.) and from the top of the popliteal space distally 4 inches (10 cm.) (Fig. 583 *a*, p. 841).

Procedure. STAGE 1. A flap of desired width to consist of skin, subcutaneous fat and deep fascia was outlined from the axillary side of the abdomen to its midline. The lateral end of this flap designed to fill the leg loss, was incised to the deep fascia on its borders for 4 inches (10 cm.). The balance of the outlined borders was incised through the skin and fat, this part of the flap elevated and tubed, and the bed closed by undermining and sliding the bordering skin (Fig. 583,*b*).

An interval of six weeks elapsed.

STAGE 2. The lateral end of the flap had been incised, elevated and delayed in this interval. The mesial attachment of the tube was excised and approximated to the ulnar side of the dorsum of the left hand and wrist (Fig. 583, *b*). The arm and forearm were fixed to the trunk with a tensor (Ace) bandage.

An interval of four months elapsed.

STAGE 3. The flap was partially and, finally, fully elevated and delayed at one month intervals during this period.

TRANSFER OF FLAP TO THE LEG. After removal of the graft and preparation of the bed, the leg was flexed 90 degrees, the thigh elevated 45 degrees, the forearm fixed on the thigh with the palmar surface of the hand over the knee, and the flap approximated to the defect with 00000 Dermalon. The arm and leg were fixed in position with a plaster dressing containing strips of thin perforated strap iron (Fig. 583, *c*).

An interval of five weeks elapsed.

STAGE 4. AMPUTATION OF THE TUBE FROM THE LEG AND ARM. READJUSTMENT OF THESE AREAS. The area of dry gangrene at the distal end of the flap was excised and the borders approximated with 00000 Dermalon.

The result of the procedure is presented in Figure 583, *d*.

Case VI. Tube Flap on a Carrier; Traumatic Loss and Laceration of Leg. A youth, aged seventeen, had been injured in an automobile accident five months before this examination. He had a laceration of the entire popliteal space, a torn peroneal nerve and biceps tendon, and partial laceration of the lateral hamstring.

The wound was débrided and closed with a plaster dressing. This was removed because of drainage and separation of the approximation. Split skin grafts applied on two later occasions failed to grow.

At this examination the area was largely healed by dense scar and leg extension limited to about 135 degrees (Fig. 584, *a*, *b*, p. 843).

Procedure. STAGE 1. A thoraco-epigastric flap 7 by 8½ inches (17.5 by 21.5 cm.) was elevated and tubed. The flap was covered with split skin from the left thigh (Fig. 584, *c*).

An interval of three weeks elapsed.

STAGE 2. A flap for attachment was outlined on the proximal end of the tube. Its mesial half was incised, elevated and delayed.

An interval of three weeks elapsed.

STAGE 3. The lateral half of the proximal flap was elevated and delayed during this interval.

TRANSFER OF THIS PROXIMAL END TO THE FLAP TO THE RIGHT FOREARM. The borders of the base defect were approximated by undermining and suturing.

The distal, abdominal end of the flap was elevated and delayed at intervals of three weeks.

An interval of three months elapsed.

STAGE 4. TRANSFER OF FLAP FROM THE ABDOMEN TO THE PREPARED POPLITEAL AREA. The flap was approximated with 00000 Dermalon sutures and dressed. The thigh was flexed and rotated laterally, the leg flexed 45 degrees, the arm fixed to the trunk, and the palmar surface of the hand placed against the lateral side of the knee and leg. These positions were fixed with plaster dressing containing thin strips of perforated strap iron for reinforcement. A strip included in the leg bandage provided a stirrup over the plantar surface for support on a frame (Fig. 584, *d*).

An interval of two months elapsed.



Fig. 584 Case VI traumatic loss and laceration of the leg; tubed flap on a carrier *a* and *b* The original condition *c* preparation of the tubed flap on the thorax and abdomen, *d* the transference and approximation of the flap to the leg.

STAGE 5 INCISION OF ABOUT ONE HALF OF THE PEDICLE.

An interval of one week elapsed

STAGE 6 COMPLETE INCISION OF TUBE PEDICLE, REMOVABLE OF THE PLASTER DRESSING APPROXIMATION OF THE EXCISED TUBE TO THE MESIAL BORDER OF THE POPLITEAL SPACE (Fig. 585 *a b* p 844)

An interval of two months elapsed.

STAGE 7 The tube was opened and spread flat. The popliteal scar was removed and the flap approximated to the normal borders.

An interval of three months elapsed.

STAGE 8 Parts of the flap approximation were adjusted.

The result of the procedure is presented in Figure 585 *c d*

Case VII. Cross Leg Pedicle Flap; Chronic Post Traumatic Ulcers of the Medial Side and Lower Third of the Left Leg. A man aged thirty-two had been struck by shell fragments which caused avulsion of tissues from the posterior middle and lower thirds of the left leg. This included the gastrocnemius muscle the

lateral edge of the tibia mesially 2½ inches (6.25 cm.) and from the top of the popliteal space distally 4 inches (10 cm.) (Fig. 583 *a*, p. 841).

Procedure. STAGE 1. A flap of desired width to consist of skin, subcutaneous fat and deep fascia was outlined from the axillary side of the abdomen to its midline. The lateral end of this flap designed to fill the leg loss, was incised to the deep fascia on its borders for 4 inches (10 cm.). The balance of the outlined borders was incised through the skin and fat, this part of the flap elevated and tubed, and the bed closed by undermining and sliding the bordering skin (Fig. 583,*b*).

An interval of six weeks elapsed.

STAGE 2. The lateral end of the flap had been incised, elevated and delayed in this interval. The mesial attachment of the tube was excised and approximated to the ulnar side of the dorsum of the left hand and wrist (Fig. 583 *b*). The arm and forearm were fixed to the trunk with a tensor (Ace) bandage.

An interval of four months elapsed.

STAGE 3. The flap was partially and, finally, fully elevated and delayed at one month intervals during this period.

TRANSFER OF FLAP TO THE LEG. After removal of the graft and preparation of the bed, the leg was flexed 90 degrees, the thigh elevated 45 degrees, the forearm fixed on the thigh with the palmar surface of the hand over the knee and the flap approximated to the defect with 00000 Dermalon. The arm and leg were fixed in position with a plaster dressing containing strips of thin perforated strap iron (Fig. 583 *c*).

An interval of five weeks elapsed.

STAGE 4. AMPUTATION OF THE TUBE FROM THE LEG AND ARM. READJUSTMENT OF TISSUE AREAS. The area of dry gangrene at the distal end of the flap was excised and the borders approximated with 00000 Dermalon.

The result of the procedure is presented in Figure 583 *d*.

Case VI. Tube Flap on a Carrier; Traumatic Loss and Laceration of Leg. A youth aged seventeen, had been injured in an automobile accident five months before this examination. He had a laceration of the entire popliteal space, a torn peroneal nerve and biceps tendon and partial laceration of the lateral hamstring.

The wound was débrided and closed with a plaster dressing. This was removed because of drainage and separation of the approximation. Split skin grafts applied on two later occasions failed to grow.

At this examination the area was largely healed by dense scar and leg extension limited to about 135 degrees (Fig. 584 *a*, *b*, p. 843).

Procedure. STAGE 1. A thoraco-epigastric flap 7 by 8½ inches (17.5 by 21.5 cm.) was elevated and tubed. The flap was covered with split skin from the left thigh (Fig. 584 *c*).

An interval of three weeks elapsed.

STAGE 2. A flap for attachment was outlined on the proximal end of the tube. Its mesial half was incised, elevated and delayed.

An interval of three weeks elapsed.

STAGE 3. The lateral half of the proximal flap was elevated and delayed during this interval.

TRANSFER OF THIS PROXIMAL END TO THE FLAP TO THE RIGHT FOREARM. The borders of the base defect were approximated by undermining and suturing.

The distal abdominal end of the flap was elevated and delayed at intervals of three weeks.

An interval of three months elapsed.

STAGE 4. TRANSFER OF FLAP FROM THE ABDOMEN TO THE PREPARED POPLITEAL AREA. The flap was approximated with 00000 Dermalon sutures and dressed. The thigh was flexed and rotated laterally, the leg flexed 45 degrees, the arm fixed to the trunk, and the palmar surface of the hand placed against the lateral side of the knee and leg. These positions were fixed with plaster dressing containing thin strips of perforated strap iron for reinforcement. A strip included in the leg bandage provided a stirrup over the plantar surface for support on a frame (Fig. 584 *d*).

An interval of two months elapsed.



Fig. 584 Case VI traumatic loss and laceration of the leg tubed flap on a carrier *a* and *b* The original condition *c* preparation of the tubed flap on the thorax and abdomen, *d* the transference and approximation of the flap to the leg.

STAGE 5 INCISION OF ABOUT ONE HALF OF THE PEDICLE.
An interval of one week elapsed.

STAGE 6. COMPLETE INCISION OF TUBE PEDICLE, REMOVABLE OF THE PLASTER DRESSING APPROXIMATION OF THE EXCISED TUBE TO THE MESIAL BORDER OF THE POPLITEAL SPACE (Fig. 585 *a*, *b* p 844)
An interval of two months elapsed.

STAGE 7 The tube was opened and spread flat. The popliteal scar was removed and the flap approximated to the normal borders.
An interval of three months elapsed.

STAGE 8 Parts of the flap approximation were adjusted.
The result of the procedure is presented in Figure 585 *c d*

Case VII. Cross Leg Pedicle Flap; Chronic Post Traumatic Ulcers of the Medial Side and Lower Third of the Left Leg. A man, aged thirty-two had been struck by shell fragments which caused avulsion of tissues from the posterior middle and lower thirds of the left leg. This included the gastrocnemius muscle, the

lateral edge of the tibia mesially 2½ inches (6.25 cm.) and from the top of the popliteal space distally 4 inches (10 cm.) and from the top of the

Procedure: STAGE 1. A flap of desired width to consist of skin, subcutaneous fat and deep fascia was outlined from the axillary side of the abdomen to its midline (Fig. 583 *a*, p. 841). The lateral end of this flap designed to fill the leg loss, was incised to the deep fascia on its borders for 4 inches (10 cm.). The balance of the outlined borders was incised through the skin and fat, this part of the flap elevated and tubed, and the bed closed by undermining and sliding the bordering skin (Fig. 583,*b*).

An interval of six weeks elapsed.

STAGE 2. The lateral end of the flap had been incised, elevated and delayed in this interval. The mesial attachment of the tube was excised and approximated to the ulnar side of the dorsum of the left hand and wrist (Fig. 583 *b*). The arm and forearm were fixed to the trunk with a tensor (Ace) bandage.

An interval of four months elapsed.

STAGE 3. The flap was partially and, finally, fully elevated and delayed at one month intervals during this period.

TRANSFER OF FLAP TO THE LEG. After removal of the graft and preparation of the bed, the leg was flexed 90 degrees, the thigh elevated 45 degrees, the forearm fixed on the thigh with the palmar surface of the hand over the knee and the flap approximated to the defect with 00000 Dermalon. The arm and leg were fixed in position with a plaster dressing containing strips of thin, perforated strap iron (Fig. 583 *c*).

An interval of five weeks elapsed.

STAGE 4. AMPUTATION OF THE TUBE FROM THE LEG AND ARM. READJUSTMENT OF FIRST AREAS. The area of dry gangrene at the distal end of the flap was excised and the borders approximated with 00000 Dermalon.

The result of the procedure is presented in Figure 583 *d*.

Case VI. Tube Flap on a Carrier; Traumatic Loss and Laceration of Leg. A youth of seventeen, had been injured in an automobile accident five months before this examination. He had a laceration of the entire popliteal space, a torn peroneal nerve and biceps tendon and partial laceration of the lateral hamstring.

The wound was débrided and closed with a plaster dressing. This was removed because of drainage and separation of the approximation. Split skin grafts applied on two later occasions failed to grow.

At this examination the area was largely healed by dense scar and leg extension limited to about 135 degrees (Fig. 584 *a*, *b*, p. 843).

Procedure: STAGE 1. A thoraco-epigastric flap 7 by 8½ inches (17.5 by 21.5 cm.) was elevated and tubed. The flap was covered with split skin from the left thigh (Fig. 584 *c*).

An interval of three weeks elapsed.

STAGE 2. A flap for attachment was outlined on the proximal end of the tube. Its mesial half was incised, elevated and delayed.

An interval of three weeks elapsed.

STAGE 3. The lateral half of the proximal flap was elevated and delayed during this interval.

TRANSFER OF THIS PROXIMAL END TO THE FLAP TO THE RIGHT FOREARM. The borders of the base defect were approximated by undermining and suturing.

The distal, abdominal end of the flap was elevated and delayed at intervals of three weeks.

An interval of three months elapsed.

STAGE 4. TRANSFER OF FLAP FROM THE ABDOMEN TO THE PREPARED POPLITEAL AREA. The flap was approximated with 00000 Dermalon sutures and dressed. The thigh was flexed and rotated laterally, the leg flexed 45 degrees, the arm fixed to the trunk, and the palmar surface of the hand placed against the lateral side of the knee and leg. These positions were fixed with plaster dressing containing thin strips of perforated strap iron for reinforcement. A strip included in the leg bandage provided a stirrup over the plantar surface for support in a frame (Fig. 584 *d*).

An interval of two months elapsed.

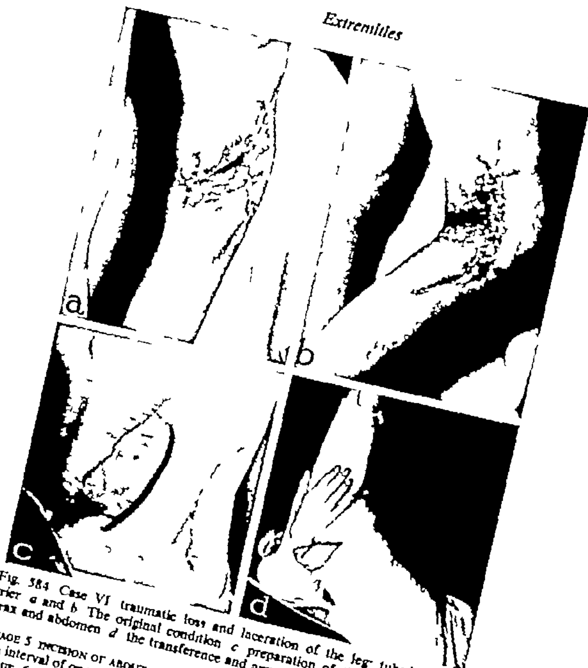


Fig. 584 Case VI traumatic loss and laceration of the leg tubed flap on a carrier *a* and *b* The original condition *c* preparation of the tubed flap on the thorax and abdomen *d* the transference and approximation of the flap to the leg.

STAGE 5 INCISION OF ABOUT ONE HALF OF THE PEDICLE.

An interval of one week elapsed.

STAGE 6. COMPLETE INCISION OF TUBE PEDICLE, REMOVABLE OF THE PLASTER DRESSING APPROXIMATION OF THE EXCISED TUBE TO THE MESIAL BORDER OF THE POPLITEAL SPACE (Fig. 585 *a*, *b* p. 844)

An interval of two months elapsed.

STAGE 7 The tube was opened and spread flat. The popliteal scar was removed and the flap approximated to the normal borders.

An interval of three months elapsed.

STAGE 8 Parts of the flap approximation were adjusted.

The result of the procedure is presented in Figure 585 *c* *d*

Case VII Cross Leg Pedicle Flap; Chronic Post-Traumatic Ulcers of the Medial Side and Lower Third of the Left Leg. A man aged thirty-two, had been struck by shell fragments which caused avulsion of tissues from the posterior middle and lower thirds of the left leg. This included the gastrocnemius muscle, the

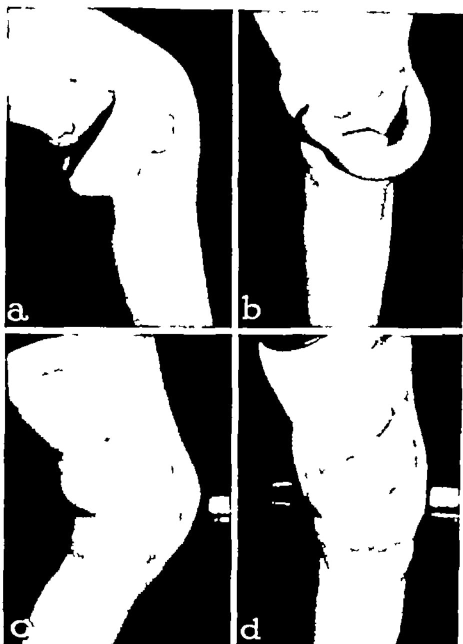


Fig. 585. Case VI (continued). a, b and c, Stages in the application of the tube; d, the finished result of the procedure.

Achilles tendon and the soft tissue overlying the peroneal muscle. The latter was probably a wound of exit.

Several procedures were undertaken in different hospital centers to heal these areas permanently during his service. These consisted of several split skin grafts, a rotated flap from the bordering skin, a cross leg flap from the anterior right thigh and a tubed pedicle flap from the abdomen transferred on the arm as a carrier. These all failed, except a part of the cross leg flap. The retention of several small metallic foreign bodies was the apparent cause of the failures.

There was a dark area 3/8 inch (1 cm.) in diameter in the retained flap over the Achilles tendon which had frequently ulcerated and which contained a foreign body of metal or leather.

There was limitation of motion in the left ankle and edema of the distal third of the leg and foot.



Fig. 586. Case VII chronic, post-traumatic ulcers of the medial side and lower third of the left leg: cross leg pedicled flap. *a* and *b* The original condition. *c* the application of the flap and the dressing support. *d* the result of the procedure.

Procedure STAGE 1 A flap was outlined on the medial surface of the middle third of the right leg with a broad base directed upward and posteriorly. The apex of the flap was near the medial edge of the tibia. This flap was of sufficient size to cover

the defect in the left leg created by excision of the ulcers and intervening skin and tissue

The borders of the flap were incised through the subcutaneous tissue. It was completely elevated above the fascia. Its blood supply was adequate for transfer.

A split skin graft from the anterior left thigh was sutured on the denuded bed of the flap and extended part way up its base.

The left leg was crossed over the right in a position to receive the flap after excision of the ulcers, and so forth. After this excision the apex of the flap was sutured to the anterior border of the excised defect and along its borders with 00000 Dermalon.

A plaster cast was applied to each leg from the upper thigh distally to include the foot. The area around the pedicle flap was left open (Fig. 586, c, p. 845).

Plaster splints between the knees at their plane of crossing and fixation of the crossed legs below the pedicle held the legs in rigid approximation.

An interval of three weeks elapsed.

STAGE 2. PARTIAL INCISION OF THE PEDICLE BASE. DELAY

An interval of eight days elapsed.

STAGE 3. COMPLETE AMPUTATION OF THE FLAP PEDICLE. REMOVAL OF THE SKIN GRAFT ON THE FLAP BASE. EXCISION OF THE REMAINING ULCER AREA ON THE LEFT LEG. APPROXIMATION OF THE FLAP WITH 00000 DERMALON SUTURES.

The result of these procedures is presented in Figure 586, d.

Case VIII. Direct Flap: Traumatic Ulcers of the Ankle and over the Achilles Tendon. A youth aged nineteen, had suffered traumatic losses 3½ inches by 2½ inch



Fig. 58[illegible]. Case VIII: traumatic ulcers of the ankle and over the Achilles tendon: direct flap from above the knee on the left thigh: cross leg procedure. a. The original condition. b. application of the flap. c. the cross leg dre[illegible]. d. the final result of the procedure.

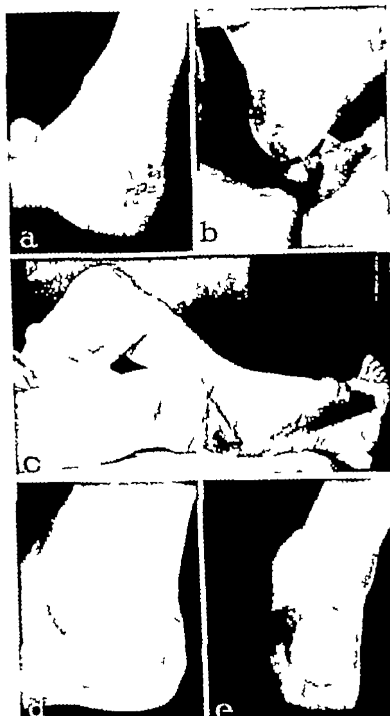


Fig. 588 Case IX painful scar on the heel cross leg direct flap. *a* The initial condition *b* the application of the flap *c* the cross leg dressing *d* and *e* the final result of the procedure

the defect in the left leg created by excision of the ulcers and intervening skin and tissue.

The borders of the flap were incised through the subcutaneous tissue. It was completely elevated above the fascia. Its blood supply was adequate for transfer.

A split skin graft from the anterior left thigh was sutured on the denuded bed of the flap and extended part way up its base.

The left leg was crossed over the right in a position to receive the flap after excision of the ulcers, and so forth. After this excision the apex of the flap was sutured to the anterior border of the excised defect and along its borders with 00000 Dermalon.

A plaster cast was applied to each leg from the upper thigh distally to include the foot. The area around the pedicle flap was left open (Fig. 586, c, p. 845).

Plaster splints between the knees at their plane of crossing and fixation of the crossed legs below the pedicle held the legs in rigid approximation.

An interval of three weeks elapsed.

STAGE 2. PARTIAL INCISION OF THE PEDICLE BASE. DELAY.

An interval of eight days elapsed.

STAGE 3. COMPLETE AMPUTATION OF THE FLAP PEDICLE. REMOVAL OF THE SKIN GRAFT ON THE FLAP BASE. EXCISION OF THE REMAINING ULCER AREA ON THE LEFT LEG. APPROXIMATION OF THE FLAP WITH 00000 DERMALON SUTURES.

The result of these procedures is presented in Figure 586, d.

Case VIII. Direct Flap. Traumatic Ulcers of the Ankle and over the Achilles Tendon. A youth, aged nineteen, had suffered traumatic losses 3½ inches by ¾ inch



FIG. 587. Case VIII: traumatic ulcers of the ankle and over the Achilles tendon; direct flap from above the knee on the left thigh; cross leg procedure. *a*, The original condition; *b*, application of the flap; *c*, the cross leg dressing; *d*, the final result of the procedure.

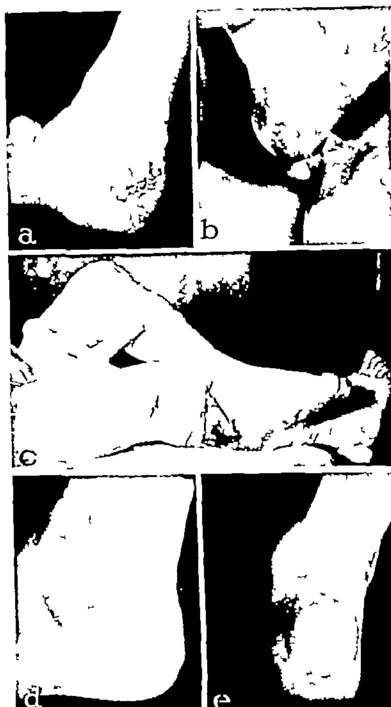


Fig. 588 Case IX, painful scar on the heel cross leg direct flap. *a* The initial condition *b* the application of the flap *c* the cross leg dressing *d* and *e* the final result of the procedure.

(9 by 2 cm.) over the internal malleolus and over the tendo achillis 1½ by 1¼ inches (3.75 by 3.1 cm.) three weeks before this examination. The granulating areas were clean (Fig. 587 *a*).

Procedure STAGE 1. A flap carrying subcutaneous fat was outlined above the knee on the left thigh. This was 4 inches (10 cm.) wide and 6 inches (15 cm.) long. It was elevated from its distal end, and its bed grafted with split skin.

The borders of the ulcers and the dividing skin strip were excised; the leg was flexed about 135 degrees with the foot on the left thigh, and the flap approximated to the defect with 00000 Dermalon. This position was maintained with a plaster dressing containing a piece of perforated strap iron for fixation and reinforcement (Fig. 587 *b*, *c*).

An interval of one month elapsed.

STAGE 2. The flap was excised from the thigh and adjusted to the border of the defect. The result is presented in Figure 587 *d*.

Case IX. Cross Leg Direct Flap: Painful Scar on the Heel. A man aged sixty six had suffered fracture of both bones of the left leg two years before this examination. He was put in pin traction with a plaster cast. An ulcer 2 inches (5 cm.) in diameter presented on the heel when the cast was removed. The healing left an adherent, painful scar. At this time the scar was 1½ inches by 1 inch (3.75 by 5 cm.) adherent to the bone and tender on palpation (Fig. 588 *a*).

Procedure STAGE 1. A flap of desired size was elevated on the lateral surface of the upper third of the right leg with its base proximal. The scar was excised from the left heel and the bordering skin slightly undermined. The left leg was flexed about 90 degrees and crossed over the right with the heel in position for the flap. The flap was approximated to the border of the defect with 00000 Dermalon. Split skin from the right thigh was applied to the flap bed and the exposed part of its base (Fig. 588 *b*).

The legs were fixed in this position with a plaster dressing containing a thin iron strap for support and rigidity (Fig. 588 *c*).

An interval of four weeks elapsed.

STAGE 2. The lateral half of the pedicle base was incised.

An interval of four days elapsed.

STAGE 3. The flap was severed and adjusted to the heel and thigh.

The result is presented in Figure 588 *d*, *e*.

Case X. Direct Flap: Traumatic Amputation of the First Toe and Avulsion of the Medial Plantar Surface of the Left Foot. A youth, aged eighteen, had caught his left foot between the platform of two cars on a train three weeks before this examination. This amputated the first toe and avulsed the plantar and medial soft tissue from an area 1½ by 2 inches (3.75 by 5 cm.). Part of the medial plantar aponeurosis, the flexor hallucis longus muscle and tendon and the distal metatarsal head was in this wound.

Procedure STAGE 1. A flap of skin and subcutaneous tissue 2½ inches (6.5 cm.) wide and 5 inches (12.5 cm.) long with its base proximal was elevated on the anterior surface of the right thigh. The denuded base was partially closed by undermining and approximation with Dermalon sutures. The remaining defect was grafted with split skin.

The left leg was flexed so that the foot rested in a position on the distal end of the thigh to receive the flap without traction or torsion. This was approximated for about [illegible] per cent of its circumference with 00000 Dermalon sutures.

A plaster dressing containing a perforated iron strap for stability fixed the foot and thigh in position (Fig. 589 *b*).

An interval of three weeks elapsed.

STAGE [illegible] AMPUTATION OF THE FLAP PEDICLE AND ADJUSTMENT OF THE TISSUE ON THE FOOT AND THIGH.

The result is presented in Figure 589 *c*.

Case XI. Cross Leg Tubed Pedicle Flap: Avulsion of the Plantar and Lateral Skin Covering: Amputation of Toes. A boy, aged eight years, attempted to mount



Fig. 589 Case X traumatic amputation of the first toe and avulsion of the mesial plantar surface of the left foot direct flap cross leg flap from the right thigh. *a*, The initial condition *b* the approximation of the cross leg flap and the left leg dressing *c* the result of the procedure. (See p. 848 for detailed discussion and procedure.)

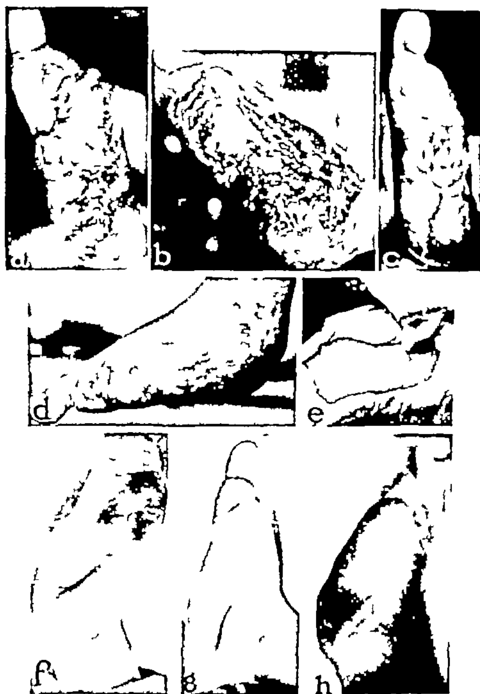


Fig. 590. Case XI: avulsion of the plantar and lateral skin covering; amputation of the toes; cross-leg tubed pedicle flap. *a* and *b*, The initial condition; *c* and *d*, the split-skingrafted lesions on both feet; *e*, the application of a tubed flap from the right thigh; *f* and *g*, stages in the application of the tubed flap; *h*, the finished result of the procedure. (See p. 848 for detailed discussion and procedure.)

a moving train and was thrown under it. There was avulsion of the skin of the lateral part of the dorsum, the lateral border approximately half of the plantar surface, the covering of the external malleolus, and the entire heel of the left foot. The second third, fourth and fifth toes were amputated at the metatarsal joints (Fig. 590 *a*, *b* p 850)

Procedure STAGE 1 Split skin 0 008 inch thick from the back was applied, basted and dressed with Furacin, adequate fluffed padding and moderate pressure The foot was placed in an irrigating pad and kept wet with saline solution.

The grafted foot is presented in Figure 590, *c* *d* This is inadequate for final repair and is to be replaced with proper covering.

An interval of one year elapsed.

STAGE 2, PREPARATION OF A TUBED PEDICLE FLAP ON THE RIGHT THIGH A flap 2¾ by 4 inches (6 by 10 cm.) was outlined between parallel incisions on the mid anterior surface of the thigh. This skin was elevated with its subcutaneous fat from the fascia and sutured as a tube The bordering skin of its base was undermined and approximated with 00 plain catgut and 00000 Dermalon surface sutures.

An interval of three weeks elapsed.

STAGE 3 TRANSFER OF THE TUBE FLAP TO THE LEFT HEEL. A flap of desired size was incised and elevated on the proximal end of the tube. Its base was covered with split skin 0 012 inch thick. The donor and recipient sites were covered with Furacin gauze and a pressure dressing.

An area the size of the flap on the left heel was excised down to the deep fascia. The heel was held in position over the right thigh and the flap approximated with 00000 Dermalon sutures. Furacin and fluffed gauze were placed over this area.

A plaster cast covered both legs from the toes up to and including the pelvis. Two braces were included across the cast to hold the legs in proximity (Fig. 590, *e* p. 850)

An interval of two weeks elapsed.

STAGE 4 OUTLINE, INCISION AND DELAY OF A FLAP ON THE DISTAL END OF THE TUBE. The proximal and distal ends of this flap (Fig. 590 *e*) remained attached, while the balance of the flap was elevated by blunt dissection and delayed.

An interval of two weeks elapsed.

STAGE 5 The borders of the proximal and distal ends of the flap were incised, elevated and sutured, and delayed. This delaying procedure was repeated again in eleven days and three weeks after this procedure.

An interval of two months elapsed.

STAGE 6 TRANSFER OF FLAP The flap was excised from the thigh its bed split skingrafted and the flap approximated to the anterior and lateral part of the foot (Fig. 590 *f* *g*) Both this and the graft were dressed with Furacin gauze and moderate pressure.

An interval of eight weeks elapsed.

STAGE 7 OPENING AND SPREADING OF THE TUBE PEDICLE. The original approximation line was incised and this tissue spread over the grafted foot surface. This grafted area was excised and the spread tube flap approximated with 00000 Dermalon sutures.

An interval of eight months elapsed.

STAGE 8 EXCISION OF THE SCAR AND ADJUSTMENT OF THE APPROXIMATION LINES. The result of these procedures is presented in Figure 590, *h*

Calcification of Scar Tissue—Ulceration

This case is presented because of its occasional occurrence in burn scarred areas with the production of recurring ulcerations The etiology of these ulcers may not be understood if the calcification consists of small foci involving fibrous tissue about the superficial blood supply This case presented multiple areas of fascia in which irregular micro-

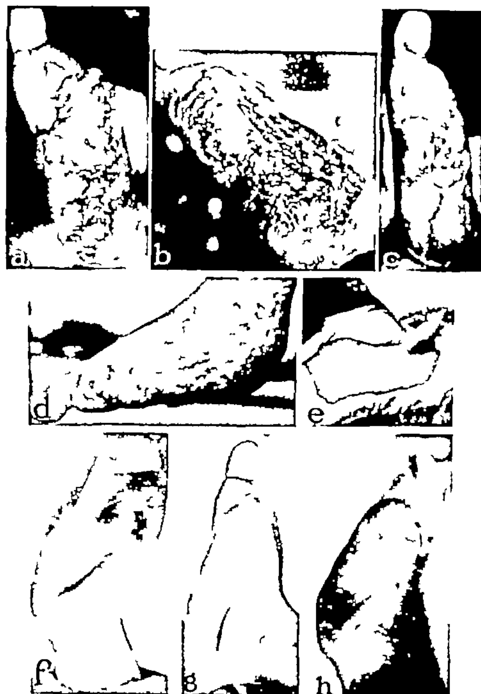


Fig. 590. Case XI: avulsion of the plantar and lateral skin covering; amputation of the toes; cross leg tubed pedicle flap. *a* and *b*: The initial condition. *c* and *d*: the split skingrafted lesions on both feet. *e*: the application of a tubed flap from the right thigh. *f* and *g*: stages in the application of the tubed flap. *h*: the finished result of the procedure. (See p. 848 for detailed discussion and procedure.)

a moving train and was thrown under it. There was avulsion of the skin of the lateral part of the dorsum, the lateral border approximately half of the plantar surface, the covering of the external malleolus, and the entire heel of the left foot. The second, third, fourth and fifth toes were amputated at the metatarsal joints (Fig. 590 *a, b* p. 850)

Procedure STAGE 1 Split skin 0.008 inch thick from the back was applied, basted and dressed with Furacin adequate fluffed padding and moderate pressure The foot was placed in an irrigating pad and kept wet with saline solution.

The grafted foot is presented in Figure 590, *c d* This is inadequate for final repair and is to be replaced with proper covering.

An interval of one year elapsed.

STAGE 2. PREPARATION OF A TUBED PEDICLE FLAP ON THE RIGHT THIGH A flap $2^3/_4$ by 4 inches (6 by 10 cm.) was outlined between parallel incisions on the mid anterior surface of the thigh. This skin was elevated with its subcutaneous fat from the fascia and sutured as a tube. The bordering skin of its base was undermined and approximated with 00 plain catgut and 00000 Dermalon surface sutures.

An interval of three weeks elapsed.

STAGE 3 TRANSFER OF THE TUBE FLAP TO THE LEFT HEEL. A flap of desired size was incised and elevated on the proximal end of the tube. Its base was covered with split skin 0.012 inch thick. The donor and recipient sites were covered with Furacin gauze and a pressure dressing.

An area the size of the flap on the left heel was excised down to the deep fascia. The heel was held in position over the right thigh and the flap approximated with 00000 Dermalon sutures Furacin and fluffed gauze were placed over this area.

A plaster cast covered both legs from the toes up to and including the pelvis Two braces were included across the cast to hold the legs in proximity (Fig. 590 *e* p 850)

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An interval of two weeks elapsed.

STAGE 5 The borders of the proximal and distal ends of the flap were incised, elevated and sutured and delayed. This delaying procedure was repeated again in eleven days and three weeks after this procedure.

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STAGE 6 TRANSFER OF FLAP The flap was excised from the thigh its bed split skingrafted and the flap approximated to the anterior and lateral part of the foot (Fig. 590 *f g*) Both this and the graft were dressed with Furacin gauze and moderate pressure.

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An interval of eight months elapsed.

STAGE 8 EXCISION OF THE SCAR AND ADJUSTMENT OF THE APPROXIMATION LINES. The result of these procedures is presented in Figure 590, *h*.

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This case is presented because of its occasional occurrence in burn scarred areas with the production of recurring ulcerations The etiology of these ulcers may not be understood if the calcification consists of small foci involving fibrous tissue about the superficial blood supply This case presented multiple areas of fascia in which irregular micro-



Fig. 590. Case XI: avulsion of the plantar and lateral skin covering, amputation of the toes; cross leg tubed pedicle flap. *a* and *b*. The initial condition. *c* and *d*, the split skingrafted lesions on both feet. *e*, the application of a tubed flap from the right thigh. *f* and *g*, stages in the application of the tubed flap. *h*, the finished result of the procedure. (See p. 848 for detailed discussion and procedure.)

a moving train and was thrown under it. There was avulsion of the skin of the lateral part of the dorsum, the lateral border approximately half of the plantar surface the covering of the external malleolus, and the entire heel of the left foot. The second, third, fourth and fifth toes were amputated at the metatarsal joints (Fig. 590 *a b* p. 850)

Procedure: STAGE 1 Split skin 0 008 inch thick from the back was applied, basted and dressed with Furacin, adequate fluffed padding and moderate pressure. The foot was placed in an irrigating pad and kept wet with saline solution.

The grafted foot is presented in Figure 590 *c d* This is inadequate for final repair and is to be replaced with proper covering.

An interval of one year elapsed.

STAGE 2. PREPARATION OF A TUBED PEDICLE FLAP ON THE RIGHT THIGH A flap 2¾ by 4 inches (6 by 10 cm) was outlined between parallel incisions on the mid-anterior surface of the thigh. This skin was elevated with its subcutaneous fat from the fascia and sutured as a tube. The bordering skin of its base was undermined and approximated with 00 plain catgut and 00000 Dermalon surface sutures.

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Calcification of Scar Tissue—Ulceration

This case is presented because of its occasional occurrence in burn scarred areas with the production of recurring ulcerations The etiology of these ulcers may not be understood if the calcification consists of small foci involving fibrous tissue about the superficial blood supply This case presented multiple areas of fascia in which irregular micro-

scopic foci of calcification had developed These were additions to other larger irregular macroscopic calculi Those in beds of the surface ulcers were mistaken for tibial sequestra until x ray examination was made.

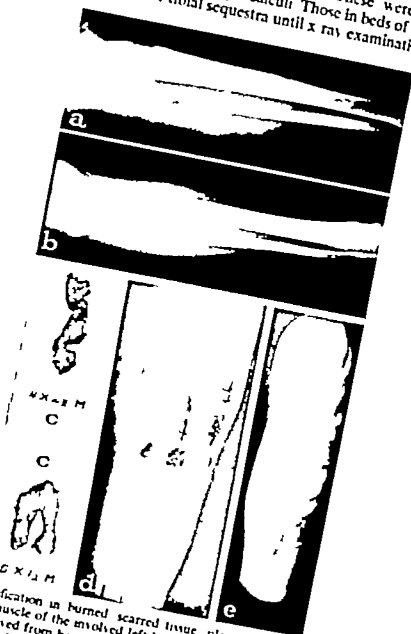


Fig 591 Calcification in burned scarred tissue ulceration *a* Calcification in the interosseous muscle of the involved left leg *b* x ray picture of the normal leg *c* the calculi removed from beneath the skin and in the subcutaneous tissue *d* the original condition of the leg *e* the healed condition after extraction of the calculi (See p 851 for detailed discussion and procedure)

Case I. A man aged twenty-eight had dense burn scar of nineteen years duration on the left leg There were several plaques of calcification in the scar over the flat surface of the tibia

There were three granulating areas one on each margin and one on the flat surface of the tibia The marginal ones were deep and each presented at its base a hard slightly movable mass against the tibia

X ray examination revealed plaques on the tibial surface and several in the dense fibrous interosseous tissue and in that posteriorly The calculi pictured in Figure 591 c (p 852) were removed from the base of each of the marginal ulcers. These plaques caused the central one.

Figure 591 *d*, presents the condition after removal of the calculi and so forth, and Figure 591 *e* the healed condition. This entire anterior scar tissue should be excised and replaced with a flap of normal skin.

Ulcers

The common ulcer of this locality is associated with venous varicosity, but occasionally results from poorly vascularized burn scars fractures, osteomyelitis trophic nerve damage or sickle cell anemia. The varicose type constitutes about 75 per cent of the cases.

They are usually shallow with slanting necrosing edges, they vary in size from small areas to complete encirclement of the leg more commonly they involve the left than the right side, and they are generally located above the internal malleolus on the lower medial aspect of the leg. The area is characterized by venous stasis, obliterative endarteritis, lymphatic sclerosis with consequent edema, and varying degrees of fibrosis in its base and the surrounding skin and subcutaneous tissues. These and frequent secondary infections result in disturbed metabolism and necrosis.

Our discussion is concerned with those cases that are beyond healing by various treatments It is probable that all ulcers reaching a size of 3 inches (7 3 cm) or more should be excised.

The plan and purpose of satisfactory surgical management is parallel in most respects with that of lymphedema (see p 831)

Owens originally and later Owens and Bethea, thoroughly discussed the several phases of this problem and described the desirable method of treatment.

Procedure. An incision to include the sclerosed, pigmented bordering skin and subcutaneous tissue is made through the deep fascia, and the included mass is thoroughly excised. All varicosities and associated veins are ligated and/or chemically sclerosed. The purpose in excising the deep fascia is to gain blood supply for the subsequent graft covering and to gain connection with the deep lymphatics The former is certain but the latter has seemed improbable in view of the lymphatic structure and the fact that there is no anastomosis of the superficial and deep lymphatic channels The fact remains, however, that the clinical results of this management have been routinely satisfactory in numerous cases over a period of years (Fig. 576 p 832)

Half thickness split skin grafts are applied immediately A single layer of surgical rayon is spread over the graft, covered by fluffed gauze or waste and fixed with a tensor (Ace) bandage The foot is splinted to prevent motion and the patient confined to bed with the leg flat for four or five days The dressing is then changed and the splint reapplied.

Supervised exercises are begun as soon as the graft is well organized The patient begins by allowing the foot to hang over the bed for one

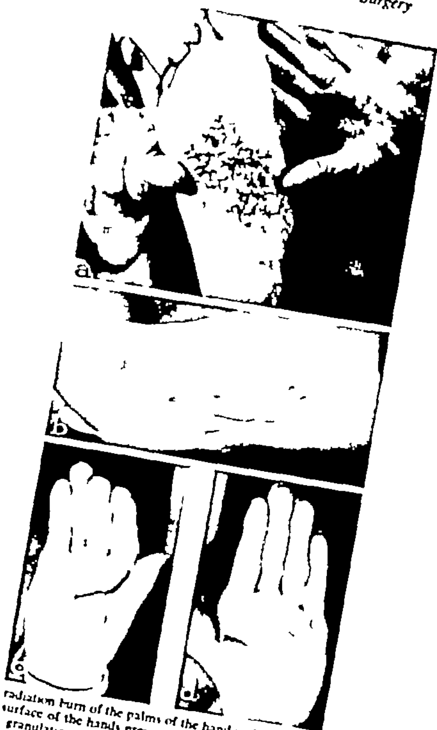


Fig. 59. X-radiation burn of the palms of the hand and the sole of the right foot. *a* The palmar surface of the hands presents scar and ulceration. There is extensive ulceration and granulation of the plantar surface of the right foot. Carcinoma squamous cell, grade II, in this area. *b* The plantar surface of the right foot repaired with a full thickness (Wolfe) graft 1 [illegible] years after the surgery. *c* and *d* The palmar surface of both hands 1 [illegible] years after repair with a tubed, pedicle flap from the abdomen. (See p. 855 for detailed discussion and procedure.)

minute. The time is increased daily until the leg may be dependent for thirty minutes without marked color changes He is then given crutches and gradually increases body support upon the foot. He should be able to walk comfortably in three weeks and return to his normal occupation in two months.

The result of this management is presented in Figure 575 (p 831)

The surgical management of these ulcers and that of lymphedema described on page 831 are identical.

Malignancy

The various malignancies are managed here as elsewhere An example is presented to emphasize several considerations.

Case I. The patient, a man aged thirty-seven, was a laboratory technician who treated a dermatitis of his hands and the right foot with x radiation. His lack of technical knowledge of this type of treatment caused failure to recognize the change from the original condition to a continued redness, burning, itching, and so forth which was a radiation reaction. The treatment was continued periodically for a long period. He finally consulted an expert dermatologist who promptly sent him for surgical management.

The condition at this examination is presented in Figure 592, *a* (p. 854) There was dense scar of the palm and hypothenar eminence of the left hand, dense scar and numerous small ulcerations of the volar surface of the right hand and extensive ulceration with new tissue growth in the plantar surface of the right foot. Biopsy established this as squamous cell carcinoma, grade II.

It is well to emphasize that this resulted from vascular sclerosis following excess radiation with recurrent and finally continuous ulceration. Such a sequence frequently results from excess radiation of any body surface (see Fig. 568 p 824 and Fig. 576 p. 832) The late effect of treatment of hemangioma and so on with beta and gamma rays, from any source, demonstrates this to some degree.

Further metastases occur late because of sclerosis and obliteration of the lymphatics and, consequently increase the opportunity of local management with reasonable assurance of success.

The method of repair of the widely excised area should furnish full thickness skin, with or without fat as indicated, to withstand wear provide a protective cushion and preclude marked scar formation with ultimate contraction, discomfort and pain.

Procedure The palms were recovered with a tubed pedicle flap from the abdomen (Fig. 592) The plantar surface of the foot was covered with a full thickness (Wolfe) graft (Fig. 592, *b*)

The patient resumed his normal activities and died fourteen years later of miliary tuberculosis.

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